2b
FL
A.I.A. FILE NO. 19-B-3

A.I.A. FILE NO. 19-B-3

Fluor
PRODUCTS COMPANY
A division of The FLUOR CORPORATION, Ltd.

Summerbell
roof structures
GENERAL OFFICES SANTA ROSA, CALIFORNIA / Write Box 1267

Olympic Chapel "Queen of the Snows," Squaw Valley, California

BY WAY OF INTRODUCTION

Fluor-Summerbell Glued Laminated Wood ARCHES, BEAMS, BOWSTRING TRUSSES and LAMELLA ROOFS offer the architect, engineer and contractor a unique *combination* of advantages:

BEAUTY—Choose your own language to describe the graceful sweep of a laminated arch . . . the rugged strength of laminated beams, or the expressive patterns suggested by a Lamella Roof. Wood is a warm, rich, natural medium that lends itself to any desired atmosphere. Fluor-Summerbell Wood Roof Structures (in a multitude of imaginative shapes and sizes) provide the designer with a limitless opportunity to express himself creatively, inside and out. With Fluor-Summerbell Roof Structures, *the form always functions!*

UTILITY—*Strength*—Glued Laminated Wood is superior in strength and dimentional stability to sawn timber.

FIRE RESISTANT—Destruction tests prove that Glued Laminated Wood units retain their position and continue to carry loads under temperatures that cause other materials to fail.

ECONOMY—Low Cost—The best way to demonstrate how Fluor-Summerbell Roof Structures hold down costs is on a bid sheet. But short of that we can cite several general economy factors: low unit cost because of production line efficiencies . . . reduction of costly splices for large spans . . . elimination of bearing walls . . . speed of erection.

NOTE:

The sections as shown on the tables in this brochure are intended to be used for preliminary design. Accurate stress analysis for the actual loading conditions should be made for each structure. This brochure has been prepared as a service to those designing glued laminated structures.

Crippled Children's Society of Los Angeles County, Ventura, California
Architect: Savo M. Stoshitch, Los Angeles, California
Structural Engineer: John A. Martin, Los Angeles, California
Full support for the curved, clear span roof deck, and the non-bearing glass walls, is provided by seven 88' constant radius arches.

Supermarket, San Carlos, California
Architect: Wurster, Bernardi & Emmons, San Francisco, California
Contractor: H. H. McDonald, San Mateo, California
Laminated wood beams, ranging from 22' to 46' in length, create a feeling of spaciousness in this modern supermarket.

Montgomery Ward Distribution Center, Oakland, California
Engineers & Builders: The Austin Company, Oakland, California
Covering an area of over 13 acres, the panelized roof system of this distribution center is supported by more than 1,000 glued laminated beams.

Elmcroft Avenue School Auditorium, Norwalk, California
Architect: Kistner, Wright & Wright, Los Angeles, California
Contractor: Albert Reingardt, Los Angeles, California
Glued laminated wood arches allow full utilization of interior space, and an unobstructed view of the stage from any point on the floor of the auditorium.

United Church of Squaw Valley, Squaw Valley Village, California
Architect: Barbachno, Ivanitsky & Watanabe, El Cerrito, California
Owner: Northern California Congregational Conferences
72 2½" x 6½" laminated mullions add a touch of gothic tradition to the non-bearing stained glass walls of this markedly different approach to chapel design.

Java Lanes Bowling Alley, Long Beach, California
Architect: Power, Daley & DeRosa, Long Beach, California
Contractor: Millie & Severson, Inc., Long Beach, California
Fluor-Summerbell Laminated Beams provide full support for the wood structural canopy over this bowling alley. The main carrying beam is 95'7" in length.

INDEX

Fluor PRODUCTS COMPANY

SUMMERBELL GLULAM

PROPERTIES OF SECTIONS

PROPERTIES OF SECTIONS GLUED LAMINATED STRUCTURAL LUMBER, 1⅜ Inch Laminations Only

*With glued laminated structural lumber, many additional sizes may be obtained. Greatest economy will result by using standard widths and depths that are multiples of standard board and dimension lumber thicknesses.

Nominal Width in Inches	Number of 1⅜" Laminations*	Net Finished Size* in Inches b h	Area of Section in Square Inches	Moment of Inertia $I = \frac{bh^3}{12}$	Section Modulus $S = \frac{bh^2}{6}$	Weight in Pounds per Linear Foot at 12% Moisture Content
3¼" WIDTH						
4	4	3¼ x 6½	21.1	74.4	22.9	4.98
4	5	3¼ x 8⅛	26.4	145.	35.8	6.23
4	6	3¼ x 9¾	31.7	251.	51.5	7.48
4	7	3¼ x 11⅜	37.0	399.	70.1	8.72
4	8	3¼ x 13	42.3	595.	91.6	9.97
4	9	3¼ x 14⅝	47.5	847.	116.	11.2
4	10	3¼ x 16¼	52.8	1,162.	143.	12.5
4¼" WIDTH						
5	4	4¼ x 6½	27.6	97.3	29.9	6.52
5	5	4¼ x 8⅛	34.5	190.	46.8	8.15
5	6	4¼ x 9¾	41.4	328.	67.3	9.78
5	7	4¼ x 11⅜	48.3	521.	91.7	11.4
5	8	4¼ x 13	55.3	778.	120.	13.0
5	9	4¼ x 14⅝	62.2	1,108.	152.	14.7
5	10	4¼ x 16¼	69.1	1,520.	187.	16.3
5	11	4¼ x 17⅞	76.0	2,023.	226.	17.9
5	12	4¼ x 19½	82.9	2,626.	269.	19.6
5	13	4¼ x 21⅛	89.8	3,339.	316.	21.2
5" WIDTH						
6	4	5 x 6½	32.5	114.	35.2	7.67
6	5	5 x 8⅛	40.6	223.	55.0	9.59
6	6	5 x 9¾	48.8	386.	79.2	11.5
6	7	5 x 11⅜	56.9	613.	108.	13.4
6	8	5 x 13	65.0	915.	141.	15.3
6	9	5 x 14⅝	73.1	1,303.	178.	17.3
6	10	5 x 16¼	81.3	1,788.	220.	19.2
6	11	5 x 17⅞	89.4	2,380.	266.	21.1
6	12	5 x 19½	97.5	3,090.	317.	23.0
6	13	5 x 21⅛	106.	3,928.	372.	24.9
6	14	5 x 22¾	114.	4,906.	431.	26.9
6	15	5 x 24⅜	122.	6,034.	495.	28.8
6	16	5 x 26	130.	7,323.	563.	30.7
5¼" WIDTH						
6	4	5¼ x 6½	34.1	120.	37.0	8.05
6	5	5¼ x 8⅛	42.7	235.	57.8	10.1
6	6	5¼ x 9¾	51.2	406.	83.2	12.1
6	7	5¼ x 11⅜	59.7	644.	113.	14.1
6	8	5¼ x 13	68.3	961.	148.	16.1
6	9	5¼ x 14⅝	76.8	1,369.	187.	18.1
6	10	5¼ x 16¼	85.3	1,877.	231.	20.1
6	11	5¼ x 17⅞	93.8	2,499.	280.	22.2
6	12	5¼ x 19½	102.	3,244.	333.	24.2
6	13	5¼ x 21⅛	111.	4,124.	390.	26.2
6	14	5¼ x 22¾	119.	5,151.	453.	28.2
6	15	5¼ x 24⅜	128.	6,336.	520.	30.2
6	16	5¼ x 26	137.	7,690.	592.	32.2
7" WIDTH						
8	5	7 x 8⅛	56.9	313.	77.0	13.4
8	6	7 x 9¾	68.3	541.	111.	16.1
8	7	7 x 11⅜	79.6	859.	151.	18.8
8	8	7 x 13	91.0	1,282.	197.	21.5
8	9	7 x 14⅝	102.	1,825.	250.	24.2
8	10	7 x 16¼	114.	2,503.	308.	26.8
8	11	7 x 17⅞	125.	3,332.	373.	29.5
8	12	7 x 19½	137.	4,325.	444.	32.2
8	13	7 x 21⅛	148.	5,499.	521.	34.9
8	14	7 x 22¾	159.	6,868.	604.	37.6
8	15	7 x 24⅜	171.	8,448.	693.	40.3
8	16	7 x 26	182.	10,250.	789.	43.0
8	17	7 x 27⅝	193.	12,300.	890.	45.6
8	18	7 x 29¼	205.	14,600.	998.	48.3
8	19	7 x 30⅞	216.	17,170.	1,112.	51.0
8	20	7 x 32½	228.	20,030.	1,232.	53.7
8	21	7 x 34⅛	239.	23,180.	1,359.	56.4
8	22	7 x 35¾	250.	26,650.	1,491.	59.1

Nominal Width in Inches	Number of 1⅜" Laminations*	Net Finished Size* in Inches b h	Area of Section in Square Inches	Moment of Inertia $I = \frac{bh^3}{12}$	Section Modulus $S = \frac{bh^2}{6}$	Weight in Pounds per Linear Foot at 12% Moisture Content
9" WIDTH						
10	6	9 x 9¾	87.8	695.	143.	20.7
10	7	9 x 11⅜	102.	1,104.	194.	24.2
10	8	9 x 13	117.	1,648.	254.	27.6
10	9	9 x 14⅝	132.	2,346.	321.	31.1
10	10	9 x 16¼	146.	3,218.	396.	34.5
10	11	9 x 17⅞	161.	4,284.	479.	38.0
10	12	9 x 19½	176.	5,561.	570.	41.4
10	13	9 x 21⅛	190.	7,071.	669.	44.9
10	14	9 x 22¾	205.	8,831.	776.	48.3
10	15	9 x 24⅜	219.	10,860.	891.	51.8
10	16	9 x 26	234.	13,180.	1,014.	55.2
10	17	9 x 27⅝	249.	15,810.	1,145.	58.7
10	18	9 x 29¼	263.	18,770.	1,283.	62.1
10	19	9 x 30⅞	278.	22,070.	1,430.	65.6
10	20	9 x 32½	293.	25,750.	1,584.	69.0
10	21	9 x 34⅛	307.	29,800.	1,747.	72.5
10	22	9 x 35¾	322.	34,270.	1,917.	75.9
10	23	9 x 37⅜	336.	39,160.	2,095.	79.4
10	24	9 x 39	351.	44,490.	2,282.	82.8
10	25	9 x 40⅝	366.	50,290.	2,476.	86.3
10	26	9 x 42¼	380.	56,560.	2,678.	89.7
10	27	9 x 43⅞	395.	63,350.	2,888.	93.2
10	28	9 x 45½	410.	70,650.	3,105.	96.6
11" WIDTH						
12	7	11 x 11⅜	125.	1,349.	237.	29.5
12	8	11 x 13	143.	2,014.	310.	33.8
12	9	11 x 14⅝	161.	2,867.	392.	38.0
12	10	11 x 16¼	179.	3,933.	484.	42.2
12	11	11 x 17⅞	197.	5,235.	586.	46.4
12	12	11 x 19½	215.	6,797.	697.	50.6
12	13	11 x 21⅛	232.	8,642.	818.	54.8
12	14	11 x 22¾	250.	10,790.	949.	59.1
12	15	11 x 24⅜	268.	13,280.	1,089.	63.3
12	16	11 x 26	286.	16,110.	1,239.	67.5
12	17	11 x 27⅝	304.	19,320.	1,399.	71.7
12	18	11 x 29¼	322.	22,940.	1,569.	75.9
12	19	11 x 30⅞	340.	26,980.	1,748.	80.2
12	20	11 x 32½	358.	31,470.	1,936.	84.4
12	21	11 x 34⅛	375.	36,430.	2,135.	88.6
12	22	11 x 35¾	393.	41,880.	2,343.	92.8
12	23	11 x 37⅜	411.	47,860.	2,561.	97.0
12	24	11 x 39	429.	54,380.	2,789.	101.
12	25	11 x 40⅝	447.	61,460.	3,026.	105.
12	26	11 x 42¼	465.	69,130.	3,273.	110.
12	27	11 x 43⅞	483.	77,420.	3,529.	114.
12	28	11 x 45½	501.	86,350.	3,795.	118.
12	29	11 x 47⅛	518.	95,930.	4,071.	122.
12	30	11 x 48¼	536.	106,200.	4,357.	127.
12	31	11 x 50⅜	554.	117,180.	4,652.	131.
12½" WIDTH						
14	8	12½ x 13	163.	2,289.	352.	38.4
14	9	12½ x 14⅝	183.	3,258.	446.	43.1
14	10	12½ x 16¼	203.	4,470.	550.	47.9
14	11	12½ x 17⅞	223.	5,949.	666.	52.7
14	12	12½ x 19½	244.	7,724.	792.	57.5
14	13	12½ x 21⅛	264.	9,820.	930.	62.3
14	14	12½ x 22¾	284.	12,270.	1,078.	67.1
14	15	12½ x 24⅜	305.	15,090.	1,238.	71.9
14	16	12½ x 26	325.	18,310.	1,408.	76.7
14	17	12½ x 27⅝	345.	21,960.	1,590.	81.5
14	18	12½ x 29¼	366.	26,070.	1,782.	86.3
14	19	12½ x 30⅞	386.	30,660.	1,986.	91.1
14	20	12½ x 32½	406.	35,760.	2,201.	95.9
14	21	12½ x 34⅛	427.	41,390.	2,426.	101.
14	22	12½ x 35¾	447.	47,590.	2,663.	105.
14	23	12½ x 37⅜	467.	54,380.	2,910.	110.
14	24	12½ x 39	488.	61,790.	3,169.	115.
14	25	12½ x 40⅝	508.	69,840.	3,438.	120.
14	26	12½ x 42¼	528.	78,560.	3,719.	125.
14	27	12½ x 43⅞	548.	87,980.	4,010.	129.
14	28	12½ x 45½	569.	98,120.	4,313.	134.
14	29	12½ x 47⅛	589.	109,010.	4,627.	139.
14	30	12½ x 48¾	609.	120,680.	4,951.	144.
14	31	12½ x 50⅜	630.	133,160.	5,287.	149.

ALLOWABLE UNIT STRESSES

Fluor PRODUCTS COMPANY

SUMMERBELL GLULAM

TABLE 1 — DRY CONDITIONS OF USE

ALLOWABLE UNIT STRESSES ARE IN POUNDS PER SQUARE INCH FOR NORMAL CONDITIONS OF LOADING

Combination Number	Extreme Fiber in Bending "f"						Tension Parallel to Grain "t"						Compression Parallel to Grain "c"						Grade Combinations		
	From 4 to 14 laminations			15 or more laminations			From 4 to 14 laminations			15 or more laminations			From 4 to 14 laminations			15 or more laminations			Grade of laminations at top and bottom	Number at top and at bottom	Grade of inner laminations
	"f"	Slope of Grain	Slope of Scarf	"f"	Slope of Grain	Slope of Scarf	"t"	Slope of Grain	Slope of Scarf	"t"	Slope of Grain	Slope of Scarf	"c"	Slope of Grain	Slope of Scarf	"c"	Slope of Grain	Slope of Scarf			
5	2600	1:16	1:10	2600	1:16	1:10	2600	1:16	1:10	2600	1:16	1:10	2200	1:15		2200	1:15		Select Structural	All	Select Structural
* 6	2600	1:16	1:10	2600	1:16	1:10	2600	1:16	1:10	2600	1:16	1:10	2000	1:15		2000	1:15		Select Structural	Two	Construction
* 7	2600	1:16	1:10	2600	1:16	1:10	2200	1:14	1:8	2400	1:16	1:10	1900	1:14		2000	1:15		Clear (Close Grain)	One	Construction
* 8	2400	1:12	1:8	2600	1:14	1:8	2600	1:14	1:8	2600	1:16	1:10	2200	1:14	All	2300	1:15	All	Dense Construction	All	Dense Construction
* 9	2400	1:12	1:8	2600	1:14	1:8	2200	1:14	1:8	2400	1:16	1:10	1900	1:14	1:5	2000	1:15	1:5	Dense Construction	1/14 of total	Construction
*10	2400	1:14	1:8	2600	1:16	1:10	2200	1:14	1:8	2400	1:16	1:10	1900	1:14		2000	1:15		Select Structural	One	Construction
*11	2600	1:16	1:10	2600	1:16	1:10	2400	1:16	1:10	2400	1:16	1:10	2000	1:15		2000	1:15		Select Structural	Two	Standard
*13	2200	1:12	1:8	2200	1:12	1:8	2000	1:12	1:8	2400	1:16	1:10	1800	1:12		1900	1:14		Select Structural	One	Standard
*14	2000	1:12	1:8	2200	1:14	1:8	2200	1:14	1:8	2400	1:16	1:10	1900	1:14		2000	1:15		Construction	All	Construction
*15	2000	1:12	1:8	2200	1:14	1:8	2000	1:12	1:8	2400	1:16	1:10	1800	1:12		1900	1:14		Construction	One	Standard
16	1600	1:10	1:5	2000	1:12	1:8	2000	1:12	1:8	2400	1:16	1:10	1800	1:12		1900	1:14		Standard	All	Standard

Horizontal Shear "H"
165

Compression Perpendicular to Grain "$c_\perp$" when lamination in bearing is
Dense 450
Close Grain 415
Medium Grain 385

Modulus of elasticity dry conditions of use
1,800,000

TABLE 2 — WET CONDITIONS OF USE

5	2000	1:16	1:10	2000	1:16	1:10	2000	1:16	1:10	2000	1:16	1:10	1600	1:15		1600	1:15		Select Structural	All	Select Structural
* 6	2000	1:16	1:10	2000	1:16	1:10	1800	1:14	1:8	1800	1:14	1:8	1500	1:15		1500	1:15		Select Structural	Two	Construction
* 7	2000	1:16	1:10	2000	1:16	1:10	1800	1:14	1:8	1800	1:14	1:8	1400	1:14		1400	1:14		Clear (Close Grain)	One	Construction
* 8	2000	1:14	1:8	2200	1:16	1:10	2000	1:14	1:8	2000	1:16	1:10	1600	1:14	All	1700	1:15	All	Dense Construction	All	Dense Construction
* 9	2000	1:14	1:8	2200	1:16	1:10	1800	1:14	1:8	1800	1:16	1:10	1400	1:14	1:10	1400	1:14	1:10	Dense Construction	1/14 of total	Construction
*10	2000	1:16	1:10	2000	1:16	1:10	1800	1:14	1:8	1800	1:16	1:10	1400	1:14		1400	1:14		Select Structural	One	Construction
*11	2000	1:16	1:10	2000	1:16	1:10	1800	1:16	1:10	1800	1:16	1:10	1400	1:14		1400	1:14		Select Structural	Two	Standard
*13	1800	1:14	1:8	1800	1:14	1:8	1600	1:12	1:8	1800	1:14	1:8	1300	1:12		1400	1:14		Select Structural	One	Standard
*14	1600	1:12	1:8	1800	1:14	1:8	1800	1:14	1:8	2000	1:18	1:12	1400	1:14		1400	1:14		Construction	All	Construction
*15	1600	1:12	1:8	1800	1:14	1:8	1600	1:12	1:8	1800	1:14	1:8	1300	1:12		1400	1:14		Construction	One	Standard
16	1200	1:10	1:5	1600	1:12	1:8	1600	1:12	1:8	1800	1:14	1:8	1300	1:12		1400	1:14		Standard	All	Standard

Horizontal Shear "H"
145

Compression Perpendicular to Grain "$c_\perp$" when lamination in bearing is
Dense 305
Close Grain 275
Medium Grain 260

Modulus of elasticity wet conditions of use
1,600,000

*For structural uses, these intermediate working stresses of the combinations indicated will satisfy most design needs, whether conditions of use are "dry" or "wet," and will provide members that closely balance bending stress and deflection requirements.

Fluor PRODUCTS COMPANY

SUMMERBELL BEAMS

FLUOR - SUMMERBELL GLUED LAMINATED WOOD BEAMS

Glued laminated wood beams have proven their greater strength, utility and economy as structural members in clear roof spans up to 300 feet.

Fluor-Summerbell Laminated Beams are available at less cost than any other comparable structural material. For all their economy, these beams provide great strength to weight ratio, dimensional stability, and fire safety.

Because of our ability to produce large quantities of duplicate members, Fluor-Summerbell Beams are the answer to modular designs . . . and for covering areas that can be measured in acres.

Hilltop High School, Chula Vista, California
Architect: Kistner, Curtis & Foster, San Diego, California
Contractor: I. C. Curry, Inc., San Diego, California
Fluor-Summerbell Tapered Beams help provide open, well lighted ceiling areas in this home economics classroom.

Fircrest Market, Sebastapol, California
Contractor: Leake & White, Builders, Sebastapol, California
62' straight laminated wood beams support this 53,600 sq. ft. western red cedar roof deck, providing a clear expanse of floor space for variety in aisle arrangement.

STRAIGHT

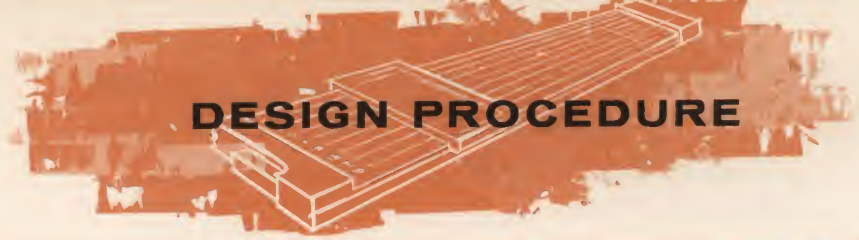
Are the most used as well as the most economical shape to fabricate. Lengths are unlimited except for shipping restrictions. Built-in camber can be easily incorporated to allow for deflections.

TAPERED

Provide economy in material and simplicity in structure where a gable roof or other architectural requirements are desired. Tapered beams as shown above should be investigated for lateral deformation at supports.

CURVED

May be used as simple beams for rise to span ratio of up to 1:30. Again, lateral deformation at supports should be considered. This shape is most economical when incorporated in arch and bowstring truss structures.



DESIGN PROCEDURE

Fluor PRODUCTS COMPANY

SUMMERBELL BEAMS

BENDING & SHEAR STRESS TABLES

(on pages 8 & 9)

Maximum allowable loads as limited by horizontal shear or bending stress for various spans and sections, are tabulated in the table on pages 8 and 9. The allowable loads are based on the criteria preceding the table.

To convert the tabulated values to other allowable limits of stress, use the following procedure:

$$\frac{\text{(Actual Allow. Stress)}}{\text{(Tabular Allow. Stress)}} \times \text{(Tabular Load)} = \text{Actual Allow. Load}$$

Note that the increase of allowable bending and shear stress for type or duration of live load and the increase in bending stress for 15 or more laminations is to be properly included to obtain the actual allowable stress.

EXAMPLE:

(a) Select a beam to span 40 ft. spaced at 16 ft. o.c. and to support a roof dead load of 15 lbs. per sq. ft. and a live load of 20 lbs. per sq. ft. (non-snow—7 day max. duration).

Uniform Load = 240 lbs. per ft. D.L.
320 lbs. per ft. L.L.
560 lbs. per ft. T.L.

Using a basic allowable stress of 2400 lbs. per sq. in. x 125%, instead of 2400 x 115% as used in the tables, the equivalent uniform load for use with the tables is:

$$560 \times \frac{1.15}{1.25} = 515 \text{ lbs. per ft.}$$

For a span of 40 ft., a 5¼" × 22¾" beam is selected and is adequate for an actual load of:

$$520 \times \frac{1.25}{1.15} = 565 \text{ lbs. per ft.}$$

DEFLECTION TABLES

(on pages 10 & 11)

Maximum allowable loads as limited by a deflection of 1/240th of the span for various spans and sections are tabulated in the table on pages 10 and 11. The allowable loads are based on the criteria preceding the table. Also included on page 11 is recommended deflection limitations to provide adequate stiffness to members for standard conditions of service.

To convert the tabulated values to other limits of deflection, use the following procedure:

$$\frac{\text{(Actual Deflection Limit)}}{\text{(Tabular Deflection Limit)}} \times \text{(Tabular Allow. Load)} = \text{Actual Allow. Load}$$

Note that the allowable load for bending or shear should never be exceeded when designing for deflection.

EXAMPLE:

(b) Check the beam in Example (a) for a live load deflection limit of L/240 and a total load deflection limit of L/180. Also find the required camber for dead load allowing an additional 50% of bending deflection for plastic deformation. Using L/240 Tables:

$$\text{Equivalent Total Load} = \frac{180}{240} \times 560$$

= 420 lbs. per ft. which is greater than live load = 320

Therefore, a 5¼" × 26" beam is required and will meet the requirement up to a load of 480 lbs. per ft.

$$\text{Camber} = \frac{240}{481} \times 1.50 \times \frac{40 \times 12}{240} = 1.5 \text{ in.}$$

(c) Check the actual bending stress of the final beam size obtained in (b) above to see what minimum combination number will be adequate:

$$f_b = \frac{560}{738} \times 2600 \times \frac{1.15}{1.25} = 1815 \text{ lbs. per sq. in.}$$

Combination No. 16 would be satisfactory for stress requirements; however, if an architectural or better finish is desired, Combination No. 14 or 10 should be specified.

Fluor PRODUCTS COMPANY

SUMMERBELL

BEAMS

ALLOWABLE UNIFORM LOAD LIMITED BY: SHEAR OR BENDING

SPAN

WIDTH	3¼ x				4¼ x														5¼ x				
DEPTH	3¼	4⅞	6½	8⅛	9¾	11⅜	13	14⅝	16¼	4⅞	6½	8⅛	9¾	11⅜	13	14⅝	16¼	17⅞	19½	21⅛	6½	8⅛	9¾	11⅜	13
10	105	237	422	659	**802**	936	1070	1202	1336	307	550	861	**1048**	1222	1399	1574	1748	1923	2098	2272	681	1064	**1296**	1511	1728
12		165	293	458	658	780	892	1002	1113	214	382	598	860	**1165**	1092	1312	1457	1603	1748	1893	473	739	1063	**1259**	1440
14			215	336	484	**658**	**765**	859	954		281	440	632	861	**999**	1124	1249	1374	1498	1623	348	543	781	1061	**1234**
16			169	258	370	504	659	**751**	835		215	337	484	659	863	**984**	1093	1202	1311	1420	266	416	598	813	1064
18				204	293	398	520	659	**742**			266	382	521	682	863	**971**	1068	1165	1262		328	473	642	841
20					237	323	422	534	658			215	310	422	552	699	860	**962**	1049	1136			383	520	681
22					196	267	348	441	544				256	349	456	578	711	859	**954**	1033			316	430	563
24						224	293	371	457				215	293	384	486	598	722	860	**947**				361	473
26							250	316	389					250	327	414	509	615	732	860					403
28							215	272	336					215	282	357	439	531	632	742					348
30								237	293						246	311	383	462	550	646					
32								209	257						216	273	336	406	484	568					
34									228							242	298	360	428	503					
36																216	266	321	382	449					
38																	238	288	343	403					
40																	215	260	310	364					
42																		236	281	330					
44																		215	256	301					
46																			234	275					
48																			215	253					
50																				233					
52																				215					
ALLOW. STRESS	$\frac{f_b = 2400}{\times 1.15}$																								

LOAD DURATION STRESS FACTORS

TYPE OF LOADING	FACTOR*
Permanent Dead or Total Load	0.90
Normal Live Load	1.00
2 Month Duration Live Load	1.15
7 Day Duration Live Load	1.25
Wind or Earthquake	1.33
Impact	2.00

*Multiply basic allowable stress by appropriate factor for actual allowable stress.

SPAN

WIDTH	9 x																						
DEPTH	9¾	11⅜	13	14⅝	16¼	17⅞	19½	21⅛	22¾	24⅜	26	27⅝	29¼	30⅞	32½	34⅛	35¾	37⅜	39	40⅝	42¼	43⅞	45½
20	658	893	1169	1477	1822	**2037**	2227	2404	2593	2771	2960												
22	544	738	966	1221	1506	1821	**2024**	2185	2358	2519	2691	2864											
24		620	812	1026	1265	1530	1820	**2003**	2161	2309	2467	2625	2773										
26			692	874	1078	1304	1552	1821	**1995**	2131	2277	2423	2559	2705									
28			596	754	930	1124	1338	1570	1821	1979	2115	2250	2377	2512	2648								
30				656	810	979	1166	1368	1587	1847	1974	2100	2218	2345	2471	2589	2716						
32				577	712	861	1024	1202	1395	**1752**	1850	1969	2080	2198	2317	2427	2546	2657					
34					631	763	907	1065	1235	1536	**1741**	1853	1957	2069	2180	2285	2396	2500	2612	2724			
36						680	809	950	1102	1370	1560	**1750**	1849	1954	2059	2158	2263	2362	2467	2572	2671		
38						611	727	853	989	1230	1400	1581	**1751**	1851	1951	2044	2144	2237	2337	2437	2530	2630	
40							656	770	893	1110	1263	1426	1598	**1759**	1853	1942	2037	2125	2220	2315	2404	2499	2593
42							595	698	810	1007	1146	1294	1450	1616	**1765**	1850	1940	2024	2115	2205	2289	2380	2470
44								636	738	917	1044	1179	1321	1472	1631	**1765**	1852	1932	2018	2105	2185	2271	2358
46								582	675	839	955	1079	1209	1347	1492	1646	**1771**	1848	1931	2013	2090	2173	2255
48									620	771	877	991	1110	1237	1370	1511	1658	**1771**	1850	1929	2003	2082	2161
50									571	711	809	913	1023	1140	1263	1393	1528	1670	**1776**	1852	1923	1999	2075
52											748	844	946	1054	1168	1288	1413	1544	1682	**1781**	1849	1922	1995
54												783	877	978	1083	1194	1310	1432	1560	1692	**1781**	1851	1921
56												728	816	909	1007	1110	1218	1332	1450	1574	1702	**1785**	1853
58													760	847	939	1035	1136	1241	1352	1467	1587	1711	**1789**
60													710	792	877	967	1061	1160	1264	1371	1483	1599	1719
62														742	821	906	994	1086	1183	1284	1389	1498	1610
64															771	850	933	1020	1111	1205	1303	1405	1511
66															725	800	877	959	1044	1133	1225	1322	1421
68																753	826	903	984	1067	1154	1245	1338
70																711	780	852	928	1007	1089	1175	1263
72																	737	806	878	952	1030	1110	1194
74																		763	831	901	975	1051	1130
76																		723	788	855	924	997	1072
78																			748	811	877	946	1017
80																				771	834	900	967
82																				734	794	856	921
84																					757	816	877
86																					722	778	837
88																						743	799
ALLOW. STRESS	$\frac{f_b = 2400}{\times 1.15}$												$\frac{f_b = 2600}{\times 1.15}$										

DESIGN CRITERIA

SIMPLE SPAN BEAMS
CONSTANT DEPTH SECTIONS
THICKNESS OF LAMINATIONS = 1⅜"
CONTINUOUS UNIFORM LOADING
2 MONTH DURATION OF LOAD

$f_v = 165 \times 1.15$

$f_b = 2400 \times 1.15$ up to 14 lams
2600×1.15 or more lams

Fluor PRODUCTS COMPANY

SUMMERBELL
BEAMS

SPAN

5¼ x								7 x																WIDTH
14⅝	16¼	17⅞	19½	21⅛	22¾	24⅜	26	8⅛	9¾	11⅜	13	14⅝	16¼	17⅞	19½	21⅛	22¾	24⅜	26	27⅝	29¼	30⅞	32½	34⅛	DEPTH
1943	2158							1417	**1728**	2014	2303	2581	2884												10
1619	1799	1978						984	1419	**1678**	1919	2151	2404	2636											12
1388	1542	1695	1843					723	1042	1418	**1645**	1843	2060	2259	2476										14
1215	1349	1483	1613	1755				554	798	1086	1416	**1613**	1803	1977	2167	2340									16
1062	**1199**	1319	1434	1560	1673			437	631	858	1119	1420	**1603**	1757	1926	2080	2235								18
860	1063	**1187**	1291	1404	1506	1619	1733		511	695	906	1150	1417	**1581**	1733	1872	2012	2163	2303						20
711	878	1065	**1173**	1278	1369	1472	1576		422	574	749	951	1171	1418	**1576**	1702	1829	1967	2093	2220					22
598	738	895	1064	**1170**	1255	1350	1444			483	630	799	984	1192	1419	**1560**	1676	1803	1919	2035	2161				24
509	629	762	907	1062	**1158**	1246	1333				536	681	839	1015	1209	1418	**1547**	1664	1771	1878	1995	2102			26
439	542	657	787	916	1063	1157	1238				463	587	723	876	1042	1223	1418	1545	1645	1744	1853	1952	2060		28
383	472	573	681	798	926	1080	1156					511	630	763	908	1065	1235	**1442**	1535	1628	1729	1822	1923	2016	30
336	415	503	599	701	814	**1012**	1083					449	554	670	798	936	1086	1395	1439	1526	1621	1708	1803	1890	32
	368	446	530	621	721	897	**1020**						490	594	707	829	962	1195	**1354**	1436	1526	1607	1697	1779	34
		398	473	554	643	800	911							530	631	740	858	1066	1214	**1357**	1441	1518	1603	1680	36
		357	425	497	577	718	817							475	566	664	770	957	1089	1229	**1365**	1438	1518	1591	38
			383	449	521	648	738								511	599	695	863	983	1109	1243	**1366**	1442	1512	40
			348	407	473	588	669								463	544	630	783	892	1006	1125	1257	**1374**	1440	42
				371	431	536	610									495	574	714	812	916	1025	1145	1268	**1374**	44
				339	394	490	558									453	525	653	743	838	939	1048	1161	1280	46
					362	450	512										483	600	683	770	859	962	1066	1176	48
					334	415	472										445	553	629	710	796	887	982	1084	50
							437												582	656	735	820	908	1002	52
																				608	679	760	842	929	54
																				566	633	707	783	864	56
																					593	659	730	805	58
																					553	616	682	753	60
																						577	639	705	62
																							600	661	64
																							564	622	66
																								586	68
			$f_b = 2400$ / $\times 1.15$			$f_b = 2600$ / $\times 1.15$									$f_b = 2400$ / $\times 1.15$			$f_b = 2600$ / $\times 1.15$							ALLOW. STRESS

11 x																					WIDTH
11⅜	13	14⅝	16¼	17⅞	19½	21⅛	22¾	24⅜	26	27⅝	29¼	30⅞	32½	34⅛	35¾	37⅜	39	40⅝	42¼	43⅞	45½	DEPTH
1090	1436	1803	2227	**2492**	2720	2935	3163	3390	3618													20
901	1179	1490	1840	2228	**2473**	2668	2875	3082	3289	3496												22
757	990	1252	1546	1877	2227	**2446**	2636	2825	3015	3205	3395											24
	844	1067	1318	1595	1897	2227	**2433**	2608	2783	2958	3134	3309										26
	728	920	1136	1376	1636	1920	2227	2422	2584	2747	2910	3072	3235									28
		802	990	1198	1425	1673	1940	2260	2412	2564	2716	2868	3019	3163	3315							30
		705	870	1053	1253	1470	1705	**2119**	2261	2404	2546	2688	2831	2965	3107	3250						32
			771	933	1110	1302	1511	1878	**2128**	2262	2396	2530	2664	2791	2925	3059	3192	3326				34
				832	990	1162	1348	1675	1906	**2137**	2263	2390	2516	2636	2762	2889	3015	3142	3268			36
				747	888	1043	1209	1503	1710	1931	**2144**	2264	2384	2497	2617	2737	2856	2976	3096	3216		38
					802	941	1092	1357	1544	1743	1955	**2151**	2265	2372	2486	2600	2714	2827	2941	3055	3169	40
					727	853	990	1231	1400	1581	1773	1975	**2157**	2259	2368	2476	2584	2693	2801	2910	3018	42
						778	902	1121	1276	1440	1615	1800	1993	**2156**	2260	2363	2467	2570	2674	2777	2881	44
						712	825	1026	1167	1318	1478	1647	1824	2011	**2162**	2261	2360	2459	2558	2657	2756	46
							758	942	1072	1210	1357	1512	1675	1847	2027	**2167**	2261	2356	2451	2546	2641	48
							699	868	988	1115	1251	1394	1544	1702	1868	2042	**2171**	2262	2353	2444	2535	50
									913	1031	1157	1289	1427	1574	1727	1888	2056	**2175**	2263	2350	2438	52
										956	1073	1195	1323	1459	1602	1751	1906	2068	**2179**	2263	2347	54
										889	997	1111	1231	1357	1489	1628	1773	1923	2080	**2182**	2264	56
											930	1036	1147	1265	1388	1517	1653	1793	1939	2091	**2186**	58
											869	968	1072	1182	1297	1418	1544	1675	1812	1954	2101	60
												906	1004	1107	1215	1328	1446	1569	1697	1830	1968	62
													942	1039	1140	1246	1357	1473	1593	1717	1847	64
													886	977	1072	1172	1276	1385	1498	1615	1737	66
														920	1010	1104	1202	1304	1411	1521	1636	68
														869	953	1042	1135	1231	1331	1436	1544	70
															901	985	1072	1164	1259	1357	1459	72
																932	1015	1102	1191	1285	1381	74
																884	963	1044	1130	1218	1310	76
																	914	991	1072	1156	1243	78
																		943	1019	1099	1182	80
																		897	970	1046	1125	82
																			925	997	1072	84
																			882	951	1023	86
																				908	977	88
			$f_b = 2400$ / $\times 1.15$					$f_b = 2600$ / $\times 1.15$														ALLOW. STRESS

Note: Loads are in lbs. per ft.
Spans are in ft.

SPAN

Fluor PRODUCTS COMPANY

SUMMERBELL BEAMS

ALLOWABLE UNIFORM LOAD LIMITED BY: DEFLECTION

WIDTH	3¼ x									4¼ x										5¼ x				
DEPTH	3¼	4⅞	6½	8⅛	9¾	11⅜	13	14⅝	16¼	4⅞	6½	8⅛	9¾	11⅜	13	14⅝	16¼	17⅞	19½	21⅛	6½	8⅛	9¾	11⅜	13
10	37	125								164	389										481				
12	21	72	172	337						95	225	440									278	543			
14		45	108	212	366						142	277	479								175	342	591		
16			73	142	246	389					95	186	321	509							118	229	396	629	
18				100	173	274	408					130	225	358	534							161	278	442	659
20				73	126	200	298	424	581			95	164	261	389	554						118	203	322	481
22					95	150	224	318	437				124	196	292	416	571						153	242	361
24					73	116	172	245	336				95	151	225	321	440	585					118	187	278
26						91	136	193	265					119	177	252	346	461	598					147	219
28						73	109	155	212					95	142	202	277	369	479	609				118	175
30							88	126	172						115	164	225	300	389	495					143
32							73	104	142						95	135	186	247	321	408					118
34								86	118							113	155	206	267	340					
36								73	100							95	130	174	225	286					
38									85								111	148	192	244					
40									73								95	127	164	209					
42																		109	142	180					
44																		95	124	157					
46																			108	137					
48																			95	121					
50																				107					
52																				95					

SPAN

RECOMMENDED MINIMUM DEFLECTION LIMITS		
USE	* LIVE LOAD ONLY	* DEAD PLUS LIVE LOAD
ROOF MEMBERS		
Industrial	L/180	L/120
Commercial & Institutional		
Without Plaster Ceiling	L/240	L/180
With Plaster Ceiling	L/360	L/240
FLOOR MEMBERS		
Ordinary Usage	L/360	L/240

*L is span length in inches for deflection in inches

WIDTH	9 x																						
DEPTH	9¾	11⅜	13	14⅝	16¼	17⅞	19½	21⅛	22¾	24⅜	26	27⅝	29¼	30⅞	32½	34⅛	35¾	37⅜	39	40⅝	42¼	43⅞	45½
20	348	552	824	1173																			
22	261	415	619	881	1209																		
24	201	320	477	679	931	1240																	
26		251	375	534	733	975	1266																
28		201	300	428	587	781	1014	1289															
30			244	348	477	635	824	1048	1308														
32			201	287	393	523	679	863	1078	1326													
34				239	328	436	566	720	899	1105	1342												
36				201	276	367	477	606	757	931	1130												
38					235	312	406	516	644	792	961	1153											
40					201	268	348	442	552	679	824	988	1173										
42						231	300	382	477	587	712	854	1014	1192									
44						201	261	332	415	510	619	743	882	1037	1209								
46							229	291	363	446	542	650	772	907	1058	1225							
48							201	256	320	393	477	572	679	798	932	1078	1240						
50								226	283	348	422	506	601	706	824	954	1097	1253					
52								201	251	309	375	450	534	628	733	848	975	1114	1266				
54									225	276	335	402	477	561	654	757	871	995	1130	1278			
56									201	248	300	360	428	503	587	679	781	892	1014	1146	1288		
58										223	270	324	385	453	528	611	703	803	912	1031	1160	1299	
60										201	244	293	348	409	477	552	635	725	824	931	1048	1173	1309
62											221	266	315	371	432	500	575	657	747	844	949	1063	1186
64											201	241	287	337	393	455	523	598	679	768	863	967	1078
66												220	261	307	358	415	477	545	619	700	787	882	983
68												201	239	281	328	379	436	498	566	640	720	806	899
70													219	258	300	348	400	457	519	587	660	739	824
72													201	237	276	320	367	420	477	539	606	679	757
74														218	254	294	338	387	439	497	559	626	698
76														201	235	272	312	357	406	458	516	577	644
78															217	251	289	330	375	424	477	534	596
80																233	268	306	348	393	442	495	552
82																216	249	284	323	365	411	460	513
84																	231	264	300	340	382	428	477
86																		246	280	316	356	397	445
88																			261	295	332	372	415

SPAN

DESIGN CRITERIA

SIMPLE SPAN BEAMS
CONSTANT DEPTH SECTIONS — D = L/360 L/240
THICKNESS OF LAMINATION = 1⅝" — E = 1,800,000
CONTINUOUS UNIFORM LOADING

Fluor PRODUCTS COMPANY

SUMMERBELL BEAMS

5¼ x								7 x																WIDTH
14⅜	16¼	17⅛	19½	21⅛	22¾	24⅜	26	8⅛	9¾	11⅜	13	14⅝	16¼	17⅛	19½	21⅛	22¾	24⅜	26	27⅝	29¼	30⅛	32½	34⅛	DEPTH
								724 456 306 215	788 528 371	839 589	879														10 12 14 16 18
684 514 396 312 250	705 543 427 342	723 569 456	738 591	752				157	271 203 157	429 323 249 196 157	641 482 371 292 234	913 686 528 415 333	941 724 570 456	964 758 607	985 788	1002										20 22 24 26 28
203 167 139 118	278 229 191 161 137	370 305 254 214 182	481 396 330 278 237	611 504 420 354 301	763 629 524 442 376	774 645 543 462	783 659 561				190 157	271 223 186 157	371 306 255 215 183	494 407 339 286 243	641 528 440 371 316	815 672 560 472 401	1018 839 699 589 501	1031 860 724 616	1043 879 747	897					30 32 34 36 38
	118	156 135 118	203 175 153 134 118	258 223 194 170 149	322 278 242 212 187	396 342 298 261 229	481 415 361 316 278						157	208 180 157	271 234 203 178 157	344 297 258 226 199	429 371 323 282 249	528 456 397 347 306	641 554 482 421 371	769 664 578 506 445	913 788 686 600 528	927 806 706 621	941 823 725	953 839	40 42 44 46 48
				132 118	165 147 131 118	203 180 161 145 130	246 219 196 175 158									176 157	220 196 175 157	271 241 215 193 173	328 292 261 234 210	394 350 313 280 252	467 416 371 333 300	550 489 436 391 352	641 570 509 456 411	742 660 589 528 475	50 52 54 56 58
						118	143 129 118											157	190 172 157	228 207 188 171 157	271 245 223 203 186	318 288 262 239 219	371 336 306 279 255	429 389 354 323 295	60 62 64 66 68

SPAN

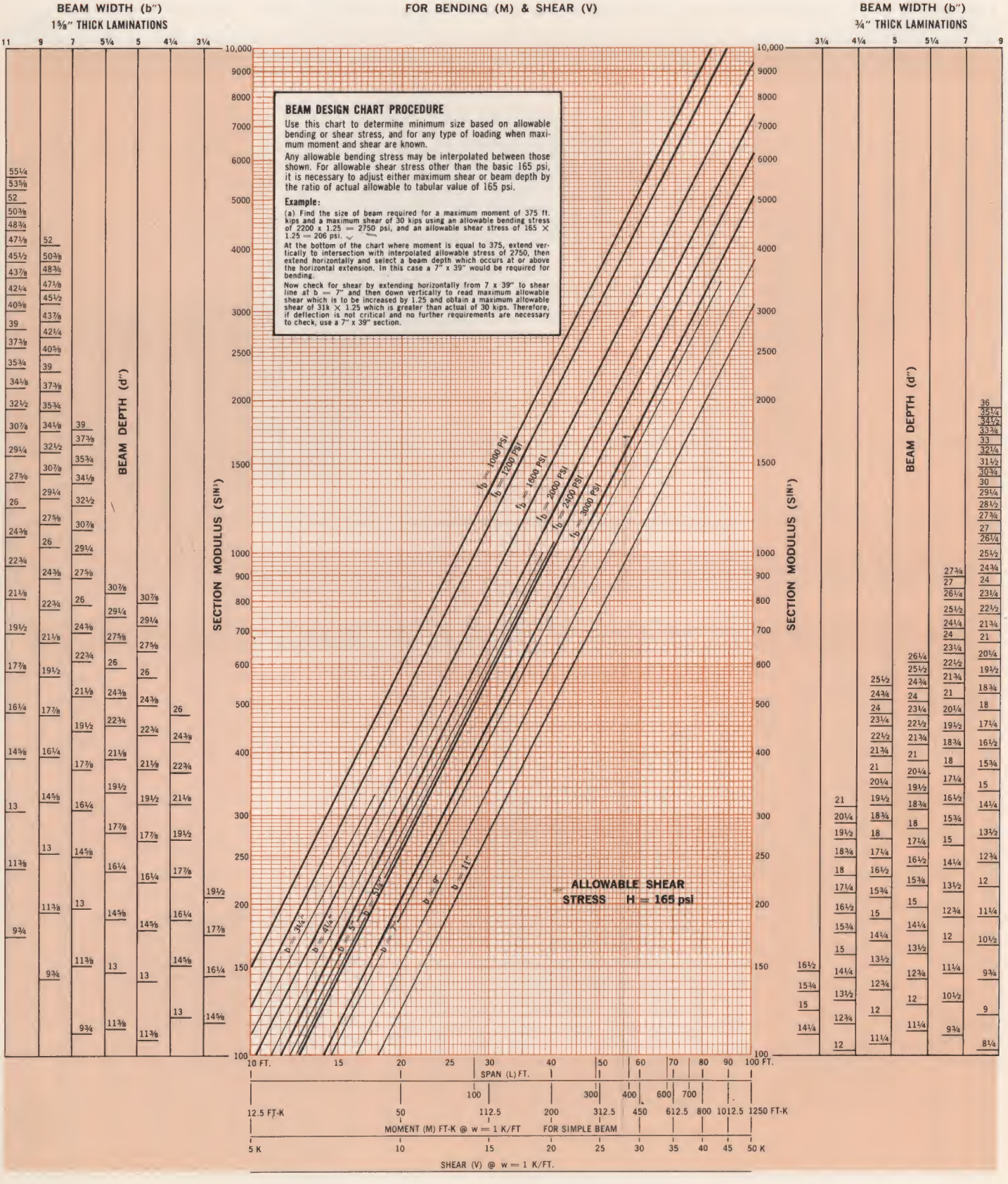
11 x																								WIDTH
11⅜	13	14⅝	16¼	17⅞	19½	21⅛	22¾	24⅜	26	27⅝	29¼	30⅞	32½	34⅛	35¾	37⅜	39	40⅝	42¼	43⅞	45½	DEPTH
675 507 391 307 246	1007 757 583 459 367	1434 1077 830 653 523	1478 1138 895 717	1515 1192 954	1547 1239	1575																20 22 24 26 28
	299 246	425 350 292 246	583 480 400 337 287	776 639 533 449 382	1007 830 692 583 496	1280 1055 880 741 630	1599 1317 1098 925 787	1621 1352 1139 968	1640 1381 1175	1409												30 32 34 36 38
			246	327 283 246	425 367 319 280 246	540 466 406 355 313	675 583 507 444 390	830 717 624 546 481	1007 870 757 662 583	1208 1043 907 794 699	1434 1239 1077 943 830	1457 1267 1109 976	1478 1293 1138	1497 1318	1515								40 42 44 46 48
						277 246	345 307 274 246	425 378 338 303 272	516 458 409 367 330	618 550 491 440 396	734 653 583 523 470	864 768 686 615 553	1007 895 800 717 645	1166 1037 926 830 747	1340 1192 1064 954 859	1532 1362 1216 1090 981	1547 1382 1239 1115	1561 1400 1260	1575 1417	1587		50 52 54 56 58
								246	299 271 246	358 324 295 269 246	425 385 350 319 292	500 453 412 376 343	583 528 480 438 401	675 612 556 507 464	776 703 639 583 533	886 803 730 666 609	1007 913 830 757 692	1138 1032 938 855 782	1280 1160 1055 962 880	1434 1300 1182 1077 985	1599 1449 1318 1202 1099	60 62 64 66 68
	NOTE: LOADS ARE IN LBS. PER FT. SPANS ARE IN FT.										268 246	315 289 267 246	367 337 311 287 265	425 391 360 332 307	489 449 414 382 353	558 513 473 436 404	634 583 537 496 459	717 659 607 560 518	806 741 683 630 583	903 830 764 706 653	1007 926 853 787 728	70 72 74 76 78
														285 264	327 304 283	374 347 323 301	425 395 367 342 319	480 446 415 387 361	540 502 467 435 406	605 562 523 487 455	675 627 583 543 507	80 82 84 86 88

SPAN

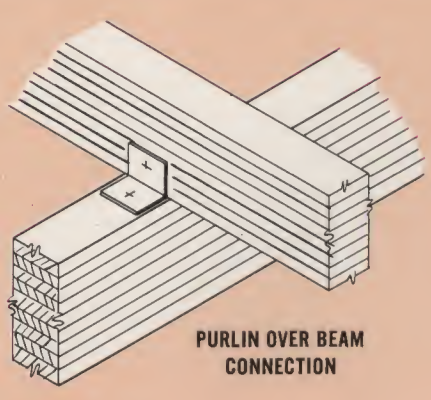
Fluor PRODUCTS COMPANY

SUMMERBELL BEAMS

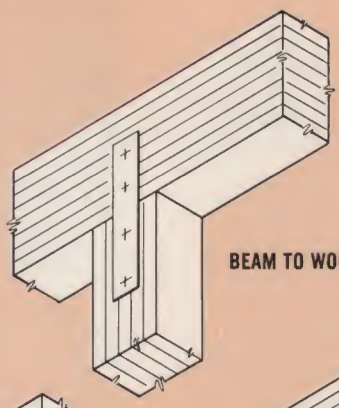
BEAM DESIGN CHART LIMITED BY: BENDING AND SHEAR



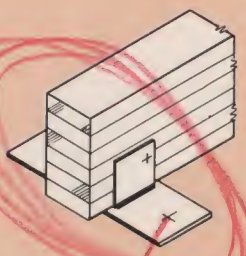
Typical Connections in a large Warehouse



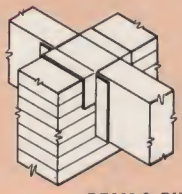
PURLIN OVER BEAM CONNECTION



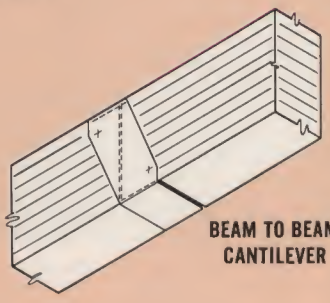
BEAM TO WOOD POST



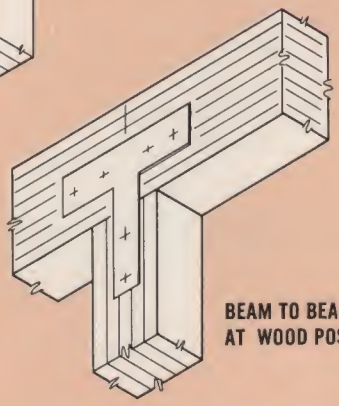
BEAM TO MASONRY



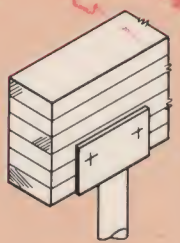
BEAM & PURLIN HANGERS



BEAM TO BEAM CANTILEVER



BEAM TO BEAM AT WOOD POST



BEAM TO PIPE COLUMN

NOTE: Concealed connections may be provided on request.

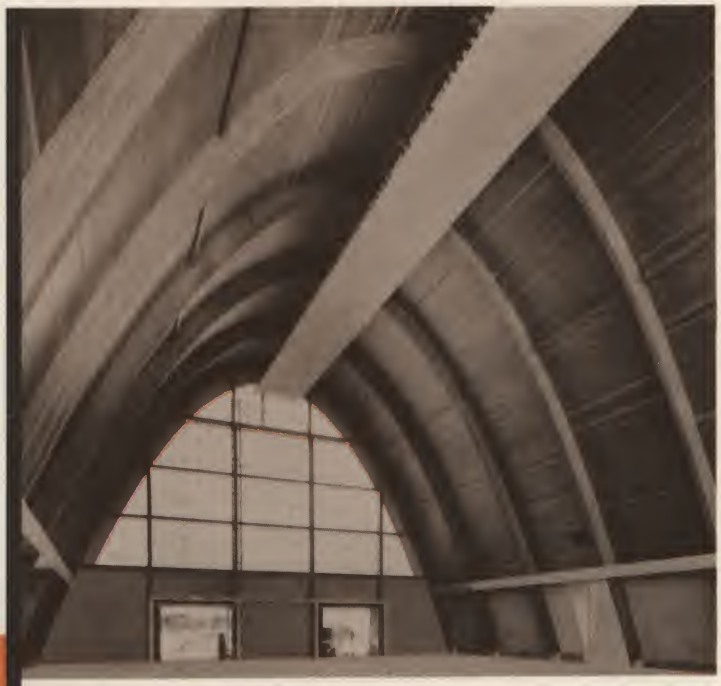
FLUOR-SUMMERBELL GLUED LAMINATED WOOD ARCHES

These arches provide the architect and engineer with the opportunity to express soaring verticals, barrel vaults, radials, gothic points—any number of classical and modern forms—through the medium of glued laminated wood structures.

Fluor-Summerbell Arches find application in any type of building. The pointed arch enjoys an understandable popularity in religious structures. Long span arches are used where large areas must be covered, such as auditoriums, schools, supermarkets, bowling alleys, and warehouses. Even a perfect dome is simple with Fluor-Summerbell Laminated Wood Arches. Radial ribs are tied to ground with concrete buttresses and framed with concentric purlins.

Light, economical, modern, Fluor-Summerbell Arches provide the architect and engineer complete freedom of expression, both in form and in function.

Typical Arches



Floral Building, Pomona, California
Architect: Gable & Wyant, Los Angeles, California
Builder: Los Angeles County Fair Association
Two-hinge tangent arches supporting a high roof structure help provide a sense of airy spaciousness in this public display building.

St. John's Lutheran Church, Montebello, California
Architect: O. J. Bruer Contractor: Don Hill Co.
Modern descendents of the gothic form, these laminated wood arches support a high peaked roof that contributes to an atmosphere of reverence and worship.

GENERAL

Besides providing economical, long, clear spans for support of vertical load, glulam arches also can provide lateral stability and rigidity for wind and earthquake loadings. Architectural and functional requirements usually determine the shape and type of arch to be used. Shipping restrictions also should be considered in the selection and design.

Three-hinged arches provide a natural splice point for shipment of each half arch. They offer the advantage of an abrupt change in roof slope at the middle hinge point plus the fact that unequal settlement of footings will not effect an appreciable change in stresses. Three-hinged arches are statically determinate and the stress analysis is relatively simple.

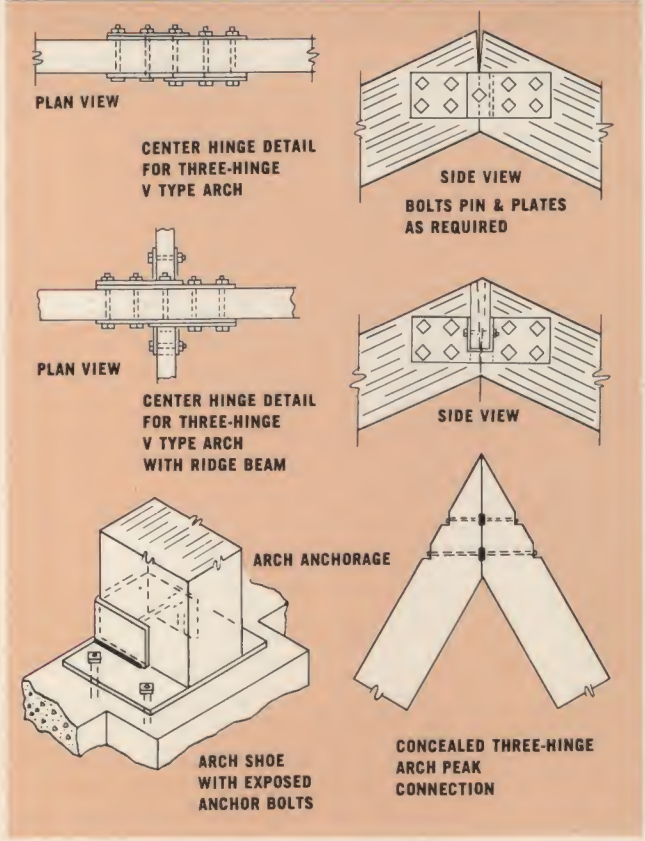
Two-hinged arches usually provide a slightly more economical section and more rigidity than three-hinged arches. Moment splices can be made at points of inflection to facilitate shipping problems. Consideration of unequal footing settlement should be considered in the design. Two-hinged arches are statically indeterminate and the stress analysis is relatively complex.

Loads should be carefully analyzed as to weight and point of application, ratio of live to dead load, and special loading conditions.

Radius of curvature affects the thickness of laminations, the allowable bending stress, and the radial tension or compression. Charts (at the bottom of this page) give the minimum radii of curvature for stock material.

The sections as shown in the tables for arches on the following pages (16, 17, 18) are intended to be used for preliminary sizes only. An accurate stress analysis for the actual design loading conditions should be made for each structure.

ARCH CONNECTION DETAILS



THREE-HINGED TANGENT ARCH

Three-hinged tangent arches usually develop maximum negative bending stress and axial stress under full vertical load. Where roof pitch is flat and rise to span ratio is low, positive moment under full vertical load may control at the tapered portion between knee and center hinge. When roof pitch is steep and light vertical loads exist, horizontal wind or earthquake loads will generally produce maximum stresses. Maximum shear stress usually occurs at the lower hinge or tangent points. The center hinge connection should be checked for unbalanced vertical live and/or horizontal loading. The members also must be checked for eccentric column action between inflection points.

The Table (on pages 16 and 17) lists the required sections for various spans, roof pitches, and wall heights as limited by combined bending and axial stresses under various loads in accordance with the criteria preceding the table.

CONSTANT RADIUS ARCHES

1. Two-hinged, constant radius, uniform depth arches generally provide the most economical arch when moment splices are not required.
2. Three-hinged, constant radius, uniform depth arches are next in line for economy when the middle hinge is considered desirable.

For both types maximum moment and combined stresses usually occur under unbalanced load at about ¼ span points. Tie rods are generally used to resist the horizontal thrust. The design considerations are somewhat the same as previously discussed.

The tables (on page 18) list the required sections for rise to span ratios of 1:6 and 1:3 for both two-hinged and three-hinged, constant radius arches as limited by combined bending and axial stresses for various spans and loading.

LIMITING CURVATURE TABLE

TYPE 1 — CONSTANT CURVATURE		TYPE 2 — TANGENT ENDS	
Tapered Section / Constant Section		Tapered Section / Constant Section	
Minimum Radius of Curvature Type 1	Net Thickness of Laminations	Minimum Radius of Curvature Type 2	
12′ - 6″ (150″)	¾″ Standard	10′ - 0″ (112″)	
40′ - 0″ (480″)	1⅜″ Standard	35′ - 0″ (420″)	

Fluor PRODUCTS COMPANY

SUMMERBELL ARCHES

THREE HINGE TANGENT ARCH SPAN-LOAD TABLE

SPAN		30′				35′				40′				45′				50′			
SLOPE	WALL HT	LOAD # / LIN. FT.				LOAD # / LIN. FT.				LOAD # / LIN. FT.				LOAD # / LIN. FT.				LOAD # / LIN. FT.			
		400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000
3/12	20	5½x12¾	5½x15	5½x17½	5½x19½	5½x14½	5½x18	5½x19½	7 x18¾	5½x15¾	5½x19½	5½x20½	7 x21¾	5½x18¾	7 x19½	7 x22½	7 x24¾	5½x20½	7 x21	7 x24	7 x26½
	18	5½x12	5½x14½	5½x16½	5½x18¾	5½x14½	5½x17½	5½x19½	5½x21	5½x15¾	5½x18¾	7 x19½	7 x21¾	5½x18	5½x21¾	7 x22½	7 x24	5½x19½	7 x20½	7 x23½	7 x26½
	16	5½x12	5½x14½	5½x15¾	5½x18	5½x13½	5½x16½	5½x18¾	5½x20½	5½x15	5½x18	5½x21	7 x20½	5½x16½	5½x21	7 x21	7 x23½	5½x18	7 x20½	7 x21¾	7 x24¾
	14	5½x11½	5½x13½	5½x15	5½x16½	5½x13½	5½x15¾	5½x18	5½x19½	5½z14½	5½x17½	5½x20½	7 x19½	5½x15¾	5½x20½	7 x19½	7 x22½	5½x16½	7 x19½	7 x20½	7 x24
	12	3½x12¾	5½x12	5½x14½	5½x15¾	5½x12¾	5½x15	5½x17½	5½x18¾	5½x12¾	5½x15¾	5½x18¾	5½x21	5½x15	5½x18	5½x21	7 x21¾	5½x15¾	5½x19½	7 x19½	7 x22½
	10	3½x11½	5½x11½	5½x12¾	5½x15	5½x12	5½x14½	5½x15¾	5½x18	5½x12	5½x15	5½x18	5½x20½	5½x14½	5½x17½	5½x20½	7 x19½	5½x16½	5½x18	7 x18	7 x21
	8	3½x10½	5½x 9¾	5½x12	5½x12¾	5½x11	5½x13½	5½x15	5½x16½	5½x11½	5½x14½	5½x17½	5½x20½	5½x12¾	5½x16½	5½x19½	7 x19½	5½x12¾	5½x17½	7 x17½	7 x20½
4/12	20	5½x12¾	5½x15	5½x16½	5½x19½	5½x14½	5½x17½	5½x20½	7 x19½	5½x16½	5½x19½	7 x19½	7 x21¾	5½x18¾	7 x18¾	7 x21¾	7 x24¾	5½x19½	7 x20½	7 x23½	7 x26½
	18	5½x12	5½x15	5½x16½	5½x18	5½x14½	5½x16½	5½x18¾	5½x21	5½x15¾	5½x18¾	5½x22½	7 x21	5½x17½	5½x20½	7 x20½	7 x22½	5½x18¾	7 x19½	7 x22½	7 x24
	16	5½x12	5½x14½	5½x15¾	5½x17½	5½x13½	5½x16½	5½x18¾	5½x21	5½x15	5½x18	5½x21	7 x20½	5½x16½	5½x19½	7 x19½	7 x21¾	5½x18	7 x19½	7 x21¾	7 x24
	14	5½x11½	5½x13½	5½x15	5½x16½	5½x12¾	5½x15¾	5½x18	5½x20½	5½x14½	5½x17½	5½x19½	7 x19½	5½x15¾	5½x18¾	7 x19½	7 x21	5½x16½	5½x20½	7 x20½	7 x22½
	12	3½x12¾	5½x12¾	5½x14½	5½x15¾	5½x12	5½x14½	5½x16½	5½x18¾	5½x13½	5½x15¾	5½x18	5½x20½	5½x15	5½x18¾	5½x20½	7 x20½	5½x15¾	5½x18	7 x18	7 x21¾
	10	3½x12	5½x12	5½x12¾	5½x14½	5½x11½	5½x13½	5½x15¾	5½x17½	5½x11½	5½x14½	5½x17½	5½x19½	5½x13½	5½x16½	5½x18¾	5½x21	5½x14½	5½x17½	5½x21	7 x20½
	8	3½x 9¾	3½x12¾	5½x12	5½x15	3½x12¾	5½x12	5½x14½	5½x16½	5½x10½	5½x12¾	5½x15¾	5½x18¾	5½x12¾	5½x15	5½x18	5½x20½	5½x13½	5½x15¾	5½x19½	7 x19½
6/12	20	5½x12¾	5½x15	5½x16½	5½x18¾	5½x13½	5½x16½	5½x19½	5½x20½	5½x15¾	5½x18¾	7 x18¾	7 x21¾	5½x17½	5½x20½	7 x21	7 x23½	5½x19½	7 x20½	7 x23½	7 x25½
	18	5½x12	5½x14½	5½x15¾	5½x18	5½x12½	5½x16½	5½x18¾	5½x19½	5½x15¾	5½x18¾	5½x21	7 x21	5½x17½	5½x20½	7 x21	7 x22½	5½x18¾	7 x19½	7 x22½	7 x24
	16	5½x12	5½x14½	5½x15¾	5½x17½	5½x12¾	5½x15¾	5½x18	5½x20½	5½x15	5½x17½	5½x20½	7 x19½	5½x16½	5½x19½	7 x19½	7 x21¾	5½x17½	7 x18¾	7 x21¾	7 x24
	14	5½x11½	5½x12¾	5½x15	5½x16½	5½x12	5½x15	5½x17½	5½x18¾	5½x14½	5½x16½	5½x18¾	7 x18¾	5½x15¾	5½x18¾	5½x21	7 x21	5½x16½	5½x20½	7 x19½	7 x22½
	12	3½x12¾	5½x12¾	5½x14½	5½x15¾	5½x11½	5½x14½	5½x16½	5½x18	5½x12¾	5½x15¾	5½x18	5½x20½	5½x14½	5½x17½	5½x20½	7 x20½	5½x15¾	5½x18¾	7 x19½	7 x21
	10	3½x11½	5½x11½	5½x12¾	5½x14½	5½x10½	5½x13½	5½x15¾	5½x17½	5½x12	5½x14½	5½x15¾	5½x18	5½x13½	5½x15¾	5½x18	5½x21	5½x14½	5½x16½	5½x19½	7 x18¾
	8	3½x10½	5½x 9¾	5½x12	5½x12¾	3½x12	5½x12	5½x12¾	5½x15	5½x10½	5½x12¾	5½x14½	5½x15¾	5½x12¾	5½x14½	5½x16½	5½x18¾	5½x13½	5½x15¾	5½x18¾	7 x18
8/12	20	5½x12¾	5½x15	5½x17½	5½x18¾	5½x13½	5½x16½	5½x18¾	5½x20½	5½x15¾	5½x18¾	7 x18¾	7 x21¾	5½x17½	5½x20½	7 x20½	7 x22½	5½x18¾	7 x18¾	7 x21¾	7 x24
	18	5½x12	5½x14½	5½x16½	5½x18	5½x12¾	5½x16½	5½x18¾	5½x20½	5½x15¾	5½x18¾	5½x21	7 x21	5½x17½	5½x20½	7 x20½	7 x22½	5½x18	7 x18¾	7 x21¾	7 x24
	16	5½x12	5½x14½	5½x15¾	5½x17½	5½x12¾	5½x15	5½x17½	5½x19½	5½x15¾	5½x18	5½x20½	7 x19½	5½x16½	5½x19½	7 x19½	7 x21¾	5½x16½	5½x21	7 x21	7 x23½
	14	5½x11½	5½x13½	5½x15	5½x17½	5½x12	5½x14½	5½x16½	5½x18¾	5½x14½	5½x16½	5½x19½	5½x21	5½x15	5½x18	7 x18¾	7 x20½	5½x15¾	5½x19½	7 x19½	7 x21¾
	12	5½x10½	5½x12¾	5½x14½	5½x15¾	5½x11½	5½x13½	5½x15¾	5½x18	5½x13½	5½x15¾	5½x18	5½x20½	5½x14½	5½x17½	5½x19½	7 x19½	5½x15	5½x18¾	5½x21	7 x20½
	10	3½x12	5½x12	5½x13½	5½x15	5½x10½	5½x13½	5½x15	5½x16½	5½x12	5½x15	5½x16½	5½x18¾	5½x12¾	5½x15¾	5½x18	5½x21	5½x13½	5½x16½	5½x18¾	7 x19½
	8	3½x11½	3½x12¾	5½x12	5½x13½	3½x12¾	5½x11½	5½x12¾	5½x15¾	5½x11½	5½x13½	5½x15	5½x16½	5½x12	5½x15	5½x16½	5½x18¾	5½x12	5½x15¾	5½x17½	7 x18¾
10/12	20	5½x12	5½x14½	5½x16½	5½x18	5½x13½	5½x15¾	5½x18	5½x20½	5½x15	5½x18	5½x21	7 x21	5½x17½	5½x20½	7 x19½	7 x21¾	5½x18	7 x18¾	7 x21	7 x22½
	18	5½x12	5½x14½	5½x16½	5½x18	5½x12¾	5½x15¾	5½x18	5½x20½	5½x15	5½x18	5½x20½	7 x19½	5½x16½	5½x20½	5½x21¾	7 x21	5½x17½	5½x21	7 x21	7 x21¾
	16	5½x11½	5½x13½	5½x15¾	5½x17½	5½x12¾	5½x15	5½x17½	5½x18¾	5½x14½	5½x16½	5½x19½	7 x19½	5½x15¾	5½x18¾	5½x21	7 x20½	5½x16½	5½x20½	7 x19½	7 x21¾
	14	5½x10½	5½x13½	5½x15	5½x16½	5½x12	5½x15	5½x16½	5½x18	5½x13½	5½x15¾	5½x18¾	5½x21	5½x15	5½x17½	5½x20½	7 x19½	5½x15¾	5½x18¾	7 x18¾	7 x21
	12	3½x12¾	5½x12¾	5½x14½	5½x15¾	5½x11½	5½x13½	5½x15	5½x17½	5½x12¾	5½x15¾	5½x17½	5½x19½	5½x14½	5½x17½	5½x19½	5½x21	5½x15	5½x18	5½x20½	7 x19½
	10	3½x12	5½x11½	5½x13½	5½x14½	5½x10½	5½x12	5½x14½	5½x15	5½x12	5½x14½	5½x15¾	5½x18	5½x12¾	5½x15	5½x17½	5½x19½	5½x13½	5½x15¾	5½x18¾	5½x20½
	8	3½x10½	3½x12¾	5½x11½	5½x12¾	3½x12	5½x11½	5½x12¾	5½x14½	3½x12¾	5½x13½	5½x14½	5½x16½	5½x10½	5½x13½	5½x15	5½x17½	5½x11½	5½x14½	5½x15¾	5½x18
12/12	20	5½x12¾	5½x14½	5½x16½	5½x18	5½x13½	5½x15¾	5½x18	5½x20½	5½x15	5½x18	7 x18¾	7 x20½	5½x16½	5½x19½	7 x19½	7 x21¾	5½x17½	5½x21	7 x21	7 x23½
	18	5½x12	5½x13½	5½x16½	5½x18	5½x12¾	5½x15	5½x17½	5½x19½	5½x15	5½x17½	5½x21	7 x19½	5½x15¾	5½x18¾	7 x19½	7 x21	5½x16½	5½x20½	7 x20½	7 x22½
	16	5½x12	5½x13½	5½x15	5½x17½	5½x12	5½x14½	5½x16½	5½x18	5½x14½	5½x16½	5½x20½	7 x18¾	5½x15	5½x18	7 x18¾	7 x20½	5½x15¾	5½x19½	7 x19½	7 x21¾
	14	5½x11½	5½x12¾	5½x14½	5½x16½	5½x11½	5½x13½	5½x15¾	5½x17½	5½x13½	5½x15¾	5½x18	5½x20½	5½x14½	5½x17½	5½x19½	7 x19½	5½x15¾	5½x18	5½x21	7 x20½
	12	3½x12	5½x12	5½x13½	5½x15	5½x10½	5½x12¾	5½x15	5½x16½	5½x12¾	5½x15	5½x17½	5½x19½	5½x13½	5½x16½	5½x18¾	5½x21	5½x14½	5½x17½	5½x19½	7 x19½
	10	3½x11½	5½x10½	5½x12¾	5½x13½	3½x12¾	5½x12	5½x13½	5½x15	5½x11½	5½x14½	5½x15¾	5½x17½	5½x12	5½x15	5½x16½	5½x18¾	5½x12¾	5½x15¾	5½x18	5½x19½
	8	3½x10½	3½x12	5½x11½	5½x12¾	3½x11½	5½x11½	5½x12¾	5½x14½	3½x12	5½x12¾	5½x14½	5½x15¾	5½x11½	5½x13½	5½x15¾	5½x17½	5½x12	5½x14½	5½x16½	5½x18
16/12	20	5½x13½	5½x15	5½x17½	5½x18	5½x13½	5½x15¾	5½x18	5½x19½	5½x14½	5½x16½	5½x18¾	5½x21	5½x15¾	5½x18	5½x20½	7 x19½	5½x16½	5½x19½	7 x18¾	7 x21
	18	5½x12¾	5½x14½	5½x16½	5½x17½	5½x12¾	5½x15	5½x17½	5½x18¾	5½x13½	5½x15¾	5½x18¾	5½x21	5½x15	5½x17½	5½x20½	5½x22½	5½x15¾	5½x18¾	7 x18¾	7 x21
	16	5½x12	5½x13½	5½x15¾	5½x16½	5½x12	5½x15	5½x16½	5½x18	5½x12¾	5½x15¾	5½x18	5½x19½	5½x14½	5½x16½	5½x19½	5½x21	5½x15	5½x18	5½x21	7 x20½
	14	5½x11½	5½x12¾	5½x15	5½x15¾	5½x12	5½x14½	5½x15¾	5½x17½	5½x12¾	5½x15¾	5½x17½	5½x18¾	5½x13½	5½x16½	5½x18¾	5½x20½	5½x14½	5½x17½	5½x19½	7 x19½
	12	5½x10½	5½x12	5½x14½	5½x15	5½x11½	5½x12¾	5½x15	5½x16½	5½x11½	5½x13½	5½x15¾	5½x17½	5½x12¾	5½x15	5½x17½	5½x18¾	5½x13½	5½x15¾	5½x18	5½x20½
	10	3½x12	5½x10½	5½x13½	5½x14½	5½x12¾	5½x12	5½x14½	5½x15	5½x11½	5½x12¾	5½x15	5½x16½	5½x11½	5½x14½	5½x15¾	5½x17½	5½x12¾	5½x15	5½x16½	5½x18¾
	8	3½x10½	3½x12¾	5½x12	5½x13½	3½x11½	5½x11½	5½x12¾	5½x14½	3½x12	5½x12	5½x13½	5½x15	5½x11½	5½x12¾	5½x14½	5½x15¾	5½x12	5½x13½	5½x15¾	5½x16½
		400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000
		30′				35′				40′				45′				50′			

DESIGN CRITERIA

DEAD LOAD = 50% TOTAL LOAD
LIVE LOAD = 50% TOTAL LOAD
WIND LOAD = 300 #/₃ (HORIZ.)
RADIUS OF CURVATURE @ KNEE = 10'
THICKNESS OF LAMINATIONS = ¾"

$f_b = 2400 \times 1:15$
$f_c = 1800 \times 1:15$

Fluor PRODUCTS COMPANY

SUMMERBELL
ARCHES

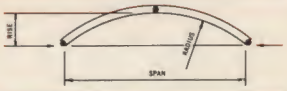
60'				70'				80'				90'				100'					SPAN
LOAD # / LIN. FT.				LOAD # / LIN. FT.				LOAD # / LIN. FT.				LOAD # / LIN. FT.				LOAD # / LIN. FT.				WALL HT.	SLOPE
400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000		
7 x21	7 x24¾	7 x28½	9 x28½	7 x24	7 x28½	9 x28½	9 x31½	7 x26¼	9 x27¾	9 x32¼	9 x34½	7 x28½	9 x30¾	9 x35¼	11x36	9 x27	9 x33¾	11x35¼	11x39	20	
7 x19½	7 x24	7 x27	9 x27	7 x22½	7 x27¾	9 x27¾	9 x30¾	7 x24¾	9 x27	9 x30¾	9 x33¾	7 x27¾	9 x30	9 x34½	11x34½	9 x27	9 x33	11x33¾	11x37½	18	
7 x18¾	7 x22½	7 x25½	9 x26¼	7 x21¾	7 x25½	9 x26¼	9 x29¼	7 x24	7 x28½	9 x28½	9 x33	7 x27	9 x29½	9 x33¾	11x33¾	9 x26¼	9 x31½	9 x36	11x36	16	
5¼x20¼	7 x21	7 x24	7 x27¾	7 x21	7 x24	7 x28½	9 x28½	7 x23¼	7 x25½	9 x27¾	9 x32¼	7 x25½	9 x27¾	9 x31½	9 x35½	9 x24¾	9 x30	9 x34½	11x35¼	14	3 / 12
5¼x18¾	7 x19½	7 x23¼	7 x25½	7 x19½	7 x22½	7 x27	9 x27	7 x23¼	7 x23¾	9 x27	9 x31½	7 x24	9 x26¼	9 x30¾	9 x34½	7 x26¼	9 x28½	9 x33	11x34½	12	
5¼x18	7 x18¾	7 x22½	7 x24¾	7 x18¾	7 x23¼	7 x25½	7 x27¾	7 x21	7 x22½	9 x25½	9 x29¼	7 x22½	9 x25½	9 x30	9 x33¾	7 x25½	9 x27	9 x32¼	11x33	10	
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	
7 x21	7 x24	7 x28½	9 x27¾	7 x22½	7 x27¾	9 x27¾	9 x31½	7 x24¾	9 x27	9 x30¾	9 x33¾	7 x27	9 x29¼	9 x33¾	11x33¾	9 x26¼	9 x31½	9 x36	11x36¾	20	
7 x19½	7 x23¼	7 x26¼	9 x26¼	7 x21¾	7 x26¼	9 x26¼	9 x30	7 x24	9 x26¼	9 x30	9 x33	7 x26¼	9 x28½	9 x33	9 x36	9 x25½	9 x30¾	9 x35¼	11x36	18	
7 x18¾	7 x22½	7 x24¾	7 x28½	7 x21	7 x24¾	9 x26¼	9 x27	7 x23¼	7 x28¼	9 x28½	9 x31½	7 x25½	9 x27¾	9 x31½	9 x35¼	7 x24¾	9 x30	9 x34½	11x35¼	16	
5¼x20¼	7 x21	7 x24	7 x27¾	7 x21	7 x24	7 x27	9 x27	7 x21¾	7 x26¼	9 x26¼	9 x30	7 x24¾	9 x26¼	9 x30	9 x33¾	7 x26¼	9 x28½	9 x33	9 x36	14	4 / 12
5¼x18	7 x19½	7 x21¾	7 x24¾	7 x18¾	7 x22½	7 x24¾	7 x27¾	7 x21	7 x25½	7 x25½	9 x29¼	7 x23¼	7 x27¾	9 x28½	9 x32¼	7 x24¾	9 x27	9 x30¾	9 x35¼	12	
5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x21	7 x21¾	7 x23¼	7 x26¼	7 x20¼	7 x24	7 x28½	9 x28½	7 x21	7 x27	9 x27¾	9 x31½	7 x22½	9 x26¼	9 x29¼	9 x34½	10	
5¼x15¾	5¼x18¾	7 x18¾	7 x22½	5¼x18¾	5¼x21¾	7 x21¾	7 x25½	—	—	—	—	—	—	—	—	—	—	—	—	8	
7 x18¾	7 x23¼	7 x26¼	9 x26¼	7 x21¾	7 x25½	9 x26¼	9 x29¼	7 x24	7 x27¾	9 x28½	9 x32¼	7 x25½	9 x27¾	9 x31½	9 x35¼	7 x27¾	9 x30	9 x33¾	11x34½	20	
7 x18¾	7 x22½	7 x24	7 x28½	7 x21	7 x24¾	9 x24¾	9 x28½	7 x23¼	7 x27¾	9 x27¾	9 x30¾	7 x24¾	9 x27	9 x30¾	9 x33¾	7 x27	9 x29¼	9 x33	11x33	18	
5¼x20¼	7 x21	7 x24	7 x27	7 x20¼	7 x24	7 x27¾	9 x27	7 x22½	7 x26¼	9 x27	9 x30	7 x23¼	7 x28½	9 x29¾	9 x32¼	7 x25½	9 x27¾	9 x31½	9 x35¼	16	
5¼x18¾	7 x20¼	7 x22½	7 x24¾	7 x18¾	7 x22½	7 x25½	7 x28½	7 x20¼	7 x24	7 x28½	9 x27¾	7 x22½	7 x27	9 x27¾	9 x30¾	7 x24	9 x26¼	9 x30	9 x33	14	6 / 12
5¼x17¼	5¼x21¾	7 x21	7 x23¼	5¼x21	7 x21	7 x24	7 x26¼	7 x19½	7 x24	7 x27¾	9 x26¼	7 x21	7 x25½	9 x25½	9 x28½	7 x22½	7 x27	9 x27¾	9 x30¾	12	
5¼x16½	5¼x21	7 x21	7 x23¼	5¼x19½	7 x20¼	7 x23¼	7 x25½	5¼x21	7 x22½	7 x25½	7 x27¾	7 x18¾	7 x23¼	9 x24	9 x27	7 x20¼	7 x24¾	7 x27¾	9 x28½	10	
5¼x15	5¼x20¼	7 x20¼	7 x22½	5¼x17¼	5¼x20¼	7 x21¾	7 x24¾	5¼x18¾	7 x21¾	7 x24	7 x25½	—	—	—	—	—	—	—	—	8	
5¼x21	7 x22½	7 x25½	7 x28½	7 x21	7 x25½	9 x26¼	9 x29¼	7 x23¼	7 x27¾	9 x28½	9 x31½	7 x24	9 x25½	9 x30	9 x33	7 x25½	9 x27¾	9 x31½	9 x35¼	20	
5¼x20¼	7 x21¾	7 x24¾	7 x27¾	7 x20¼	7 x24	7 x27¾	9 x27	7 x21¾	7 x26¼	9 x27	9 x30	7 x23¼	7 x27¾	9 x28½	9 x31½	7 x24¾	9 x27	9 x30¾	9 x33¾	18	
5¼x19½	7 x21	7 x24	7 x26¼	7 x19½	7 x23¼	7 x27	7 x30	7 x21	7 x24¾	9 x26¼	9 x29¼	7 x21¾	7 x27	9 x27	9 x30	7 x24	7 x28½	9 x29¼	9 x32¼	16	
5¼x18¾	7 x19½	7 x22½	7 x24¾	5¼x21	7 x21¾	7 x24¾	7 x27¾	7 x20¼	7 x24	7 x27¾	9 x27	7 x21	7 x25½	7 x28½	9 x28½	7 x22½	7 x27	9 x27¾	9 x30¾	14	8 / 12
5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x19½	7 x20¼	7 x24	7 x25½	7 x19½	7 x23¼	7 x25½	7 x28½	7 x19½	7 x24	7 x27	9 x27	7 x21	7 x25½	9 x25½	9 x28½	12	
5¼x16½	5¼x19½	7 x19½	7 x21¾	5¼x18	7 x18¾	7 x21¾	7 x24	5¼x19½	7 x21	7 x24	7 x26¼	5¼x20¼	7 x21¾	7 x24¾	9 x25½	7 x18¾	7 x23¼	7 x26¼	9 x27	10	
5¼x14¼	5¼x18	7 x18	7 x20¼	5¼x15¾	5¼x19½	7 x21	7 x22½	5¼x17¼	7 x20¼	7 x23¼	7 x24¾	5¼x18	7 x18¾	7 x24	9 x24¾	5¼x18¾	7 x20¼	7 x23¼	7 x27	8	
5¼x20¼	7 x21¾	7 x24¾	7 x27¾	7 x20¼	7 x24	7 x27¾	9 x27¾	7 x21¾	7 x27	9 x27	9 x30	7 x22½	7 x27¾	9 x27¾	9 x30¾	7 x24¾	9 x27	9 x30¾	9 x33¾	20	
5¼x19½	7 x21	7 x24	7 x27	7 x19½	7 x24	7 x27	9 x27	7 x21	7 x25½	7 x28½	9 x29¼	7 x21¾	7 x26¼	9 x27	9 x30	7 x24	7 x28½	9 x28½	9 x33	18	
5¼x18¾	7 x19½	7 x22½	7 x24¾	5¼x20¼	7 x22½	7 x24¾	7 x28½	7 x20¼	7 x24	7 x27¾	9 x27	7 x21	7 x25½	9 x25½	9 x28½	7 x23¼	7 x27¾	9 x28½	9 x31½	16	
5¼x17½	7 x18¾	7 x21¾	7 x24	5¼x20¼	7 x21	7 x24	7 x27¾	7 x19½	7 x22½	7 x26¼	7 x28½	7 x19½	7 x24	7 x27	9 x27	7 x21¾	7 x26¼	9 x26¼	9 x29¼	14	10 / 12
5¼x15¾	5¼x20¼	7 x20¼	7 x22½	5¼x18¾	7 x19½	7 x22½	7 x24¾	5¼x21	7 x21	7 x24¾	7 x27	5¼x21	7 x21¾	7 x25½	7 x28½	7 x20¼	7 x24	7 x27¾	9 x27	12	
5¼x15	5¼x19½	5¼x21	7 x20¼	5¼x17¼	5¼x20¼	7 x20¼	7 x22½	5¼x19½	7 x19½	7 x22½	7 x25½	5¼x18¾	7 x20¼	7 x23¼	7 x25½	5¼x21	7 x22½	7 x25½	7 x28½	10	
5¼x13½	5¼x16½	5¼x18¾	5¼x21	5¼x15	5¼x18	5¼x21	7 x20¼	5¼x18	5¼x21	7 x21	7 x24	5¼x16½	5¼x20¼	7 x20¼	7 x24	5¼x18¾	7 x19½	7 x22½	7 x25½	8	
5¼x19½	7 x20¼	7 x22½	7 x25½	7 x18¾	7 x22½	7 x26¼	7 x28½	7 x20¼	7 x24¾	7 x28½	9 x27¾	7 x22½	7 x27	9 x27	9 x30	7 x23¼	7 x28½	9 x27¾	9 x32¼	20	
5¼x18¾	7 x19½	7 x21¾	7 x24¾	5¼x20¼	7 x21¾	7 x24¾	7 x27¾	7 x18¾	7 x24	7 x27	9 x27	7 x21	7 x25½	9 x26¼	9 x29¼	7 x22½	7 x27¾	9 x27¾	9 x30¾	18	
5¼x18	7 x18¾	7 x21	7 x24	5¼x19½	7 x21	7 x24	7 x26¼	7 x18¾	7 x22½	7 x25½	7 x28½	7 x20¼	7 x24¾	7 x27¾	9 x27¾	7 x21¾	7 x26¼	9 x26¼	9 x29¼	16	
5¼x17¼	5¼x20¼	7 x19½	7 x22½	5¼x18¾	7 x20¼	7 x22½	7 x24¾	5¼x20¼	7 x21¾	7 x24¾	7 x27	7 x18¾	7 x23¼	7 x26¼	9 x26¼	7 x20¼	7 x24¾	7 x28½	9 x27¾	14	12 / 12
5¼x16½	5¼x19½	5¼x21	7 x21	5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x19½	7 x20¼	7 x23¼	7 x25½	5¼x20¼	7 x21¾	7 x24¾	7 x27¾	7 x18¾	x23¼	7 x26¼	9 x26¼	12	
5¼x15	5¼x17¼	5¼x20¼	7 x19½	5¼x15¾	5¼x19½	7 x19½	7 x21¾	5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x18¾	7 x19½	7 x22½	7 x24¾	5¼x20¼	7 x21	7 x24	7 x27	10	
5¼x13½	5¼x15¾	5¼x18	5¼x20¼	5¼x14¼	5¼x17¼	5¼x20¼	7 x20¼	5¼x15¾	5¼x18¾	7 x18¾	7 x21	5¼x16½	5¼x20¼	7 x19½	7 x23¼	5¼x18	7 x18¾	7 x21¾	7 x25½	8	
5¼x18	7 x18¾	7 x21¾	7 x24	5¼x19½	7 x21	7 x24	7 x26¼	7 x18¾	7 x22½	7 x26¼	7 x28½	7 x20¼	7 x24¾	7 x27¾	9 x27¾	7 x21¾	7 x26¼	9 x26¼	9 x29¼	20	
5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x18¾	7 x20¼	7 x23¼	7 x25½	5¼x21	7 x21¾	7 x24¾	7 x27¾	7 x19½	7 x23¼	7 x27	9 x26¼	7 x21	7 x24¾	7 x28½	9 x27¾	18	
5¼x16½	5¼x20¼	7 x20¼	7 x22½	5¼x18	7 x18¾	7 x21¾	7 x24¾	5¼x19½	7 x21	7 x24	7 x26¼	5¼x21	7 x21¾	7 x24	7 x27¾	7 x19½	7 x24	7 x27	9 x27	16	
5¼x15¾	5¼x18¾	7 x18¾	7 x21	5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x18¾	7 x19½	7 x22½	7 x24¾	5¼x20¼	7 x21	7 x24	7 x27	5¼x21	7 x22½	7 x25½	7 x28½	14	16 / 12
5¼x15	5¼x18	5¼x20¼	7 x19½	5¼x16½	5¼x19½	7 x19½	7 x21¾	5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x19½	7 x21	7 x24	7 x26¼	12					
5¼x13½	5¼x16½	5¼x18¾	5¼x21	5¼x15	5¼x18	5¼x20¼	7 x19½	5¼x16½	5¼x19½	7 x19½	7 x21¾	5¼x17¼	5¼x21	7 x21	7 x23¼	5¼x18	7 x18¾	7 x21¾	7 x24	10	
5¼x12	5¼x15	5¼x16½	5¼x18¾	5¼x13½	5¼x15¾	5¼x18	5¼x20¼	5¼x14¼	5¼x17¼	5¼x19½	5¼x21¾	5¼x15¾	5¼x18¾	7 x18¾	7 x21	5¼x16½	5¼x20¼	7 x19½	7 x21¾	8	
400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000	400	600	800	1000		
60'				70'				80'				90'				100'					

Fluor PRODUCTS COMPANY
SUMMERBELL ARCHES

CONSTANT RADIUS ARCH TABLES
TYPICAL ARCH CONNECTION DETAILS

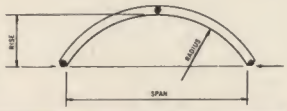
THREE-HINGE CIRCULAR ARCH

RISE = 1/6 SPAN



Span	Radius	Horiz. Thrust Kips/1000 #/ft. load	LOAD (in lbs. per foot of span) 400	600	800	1000
30'-0"	25'- 0"	22.9	3¼ x 7½	3¼ x 8¼	3¼ x 9¾	4¼ x 9
40'-0"	33'- 4"	30.5	3¼ x 9¾	4¼ x 9¾	4¼ x 11¼	4¼ x 12
50'-0"	41'- 8"	38.2	4¼ x 11⅜	4¼ x 13	5¼ x 13	5¼ x 14⅝
60'-0"	50'- 0"	45.8	4¼ x 13	5¼ x 14⅝	7 x 14⅝	7 x 14⅝
70'-0"	58'- 4"	53.5	5¼ x 13	7 x 14⅝	7 x 16¼	7 x 17⅞
80'-0"	66'- 8"	61.1	7 x 14⅝	7 x 16¼	7 x 17⅞	7 x 19½
90'-0"	75'- 0"	68.8	7 x 16¼	7 x 17⅞	7 x 21⅛	9 x 19½
100'-0"	83'- 4"	76.4	7 x 17⅞	7 x 19½	9 x 21⅛	9 x 22¾
110'-0"	91'- 8"	84.1	7 x 19½	9 x 19½	9 x 22¾	9 x 24⅜
120'-0"	100'- 0"	91.7	7 x 21⅛	9 x 21⅛	9 x 24⅜	9 x 26

RISE = 1/3 SPAN



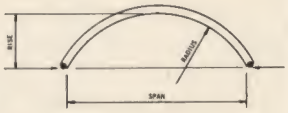
Span	Radius	Horiz. Thrust Kips/1000 #/ft. load	LOAD (in lbs. per foot of span) 400	600	800	1000
30'-0"	16'- 3"	11.88	3¼ x 8¼	3¼ x 9¾	4¼ x 9¾	4¼ x 10½
40'-0"	21'- 8"	15.82	4¼ x 9¾	4¼ x 11¼	4¼ x 12¾	5¼ x 12¾
50'-0"	27'- 0"	19.80	4¼ x 12	5¼ x 12¾	5½ x 14¼	5¼ x 15¾
60'-0"	32'- 6"	23.70	5¼ x 12¾	5¼ x 15	7 x 15	7 x 16½
70'-0"	37'-11"	27.70	5¼ x 14⅝	7 x 16¼	7 x 17⅞	7 x 19½
80'-0"	43'- 3"	31.65	7 x 14⅝	7 x 17⅞	7 x 21⅛	9 x 19½
90'-0"	48'- 9"	35.60	7 x 17⅞	7 x 19½	9 x 21⅛	9 x 22¾
100'-0"	54'- 2"	39.55	7 x 19½	9 x 21⅛	9 x 22¾	9 x 24⅜
110'-0"	59'- 9"	43.50	7 x 21⅛	9 x 22¾	9 x 24⅜	9 x 27⅝
120'-0"	65'- 0"	47.50	9 x 21⅛	9 x 24⅜	9 x 26	11 x 27⅝

TWO-HINGE CIRCULAR ARCH

RISE = 1/6 SPAN

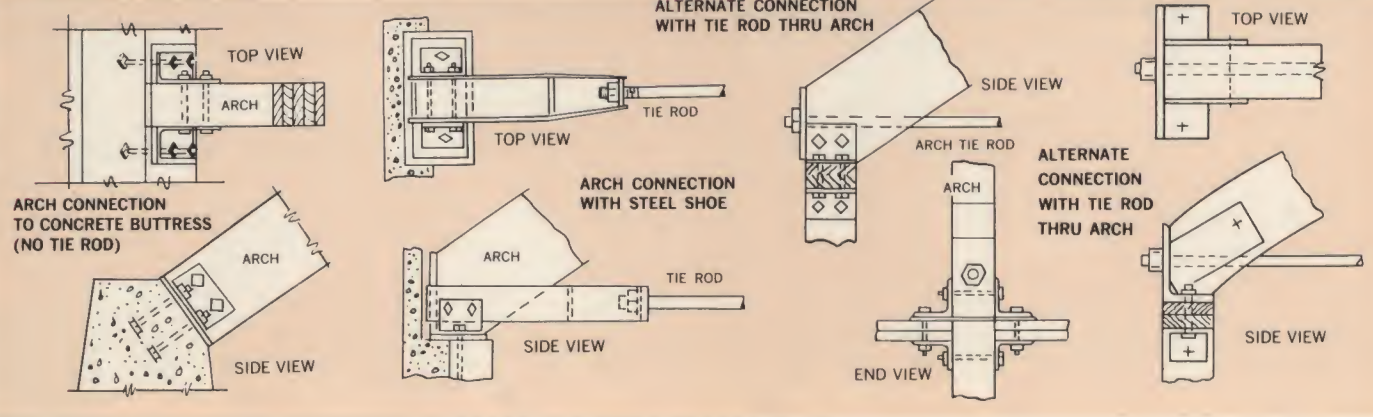
Span	Radius	Horiz. Thrust Kips/1000 #/ft. load	LOAD (in lbs. per foot of span) 400	600	800	1000
30'-0"	25'- 0"	22.8	3¼ x 6¾	3¼ x 8⅛	3¼ x 9	3¼ x 9¾
40'-0"	33'- 4"	31.0	3¼ x 9	5¼ x 8⅛	5¼ x 9¾	5¼ x 10½
50'-0"	41'- 8"	38.0	5¼ x 8⅛	5¼ x 9¾	5¼ x 11⅜	5¼ x 13
60'-0"	50'- 0"	45.5	5¼ x 11⅜	5¼ x 13	5¼ x 14⅝	5¼ x 16¼
70'-0"	58'- 4"	53.0	5¼ x 13	5¼ x 14⅝	5¼ x 16¼	7 x 16¼
80'-0"	66'- 8"	60.6	5¼ x 14⅝	5¼ x 16¼	7 x 16¼	7 x 17⅞
90'-0"	75'- 0"	68.2	5¼ x 16¼	7 x 16¼	7 x 19½	7 x 21⅛
100'-0"	83'- 4"	76.0	7 x 16¼	7 x 19½	7 x 21⅛	9 x 21⅛
120'-0"	100'- 0"	91.0	7 x 19½	7 x 21⅛	9 x 22¾	9 x 24⅜

RISE = 1/3 SPAN



Span	Radius	Horiz. Thrust Kips/1000 #/ft. load	LOAD (in lbs. per foot of span) 400	600	800	1000
30'-0"	16'- 3"	11.2	3¼ x 7½	3¼ x 9	3¼ x 9¾	5¼ x 9
40'-0"	21'- 8"	15.0	3¼ x 9¾	5¼ x 9	5¼ x 10½	5¼ x 11¼
50'-0"	27'- 1"	18.6	5¼ x 9¾	5¼ x 11¼	5¼ x 12¾	5¼ x 14¼
60'-0"	32'- 6"	22.4	5¼ x 11¼	5¼ x 13½	5¼ x 15¾	7 x 15
70'-0"	37'-11"	26.1	5¼ x 13	5¼ x 16¼	7 x 16¼	7 x 17⅞
80'-0"	43'- 4"	29.8	5¼ x 16¼	7 x 16¼	7 x 17⅞	7 x 19½
90'-0"	48'- 9"	33.6	7 x 16¼	7 x 17⅞	7 x 21⅛	9 x 21⅛
100'-0"	54'- 2"	37.4	7 x 17⅞	7 x 21⅛	9 x 21⅛	9 x 22¾
120'-0"	65'- 0"	44.8	7 x 21⅛	9 x 21⅛	9 x 24⅜	9 x 27⅝

TYPICAL CONSTANT RADIUS ARCH DETAILS



LAMELLA ROOFS

FLUOR - SUMMERBELL LAMELLA ROOFS

This versatile Fluor-Summerbell roof system provides clear spans up to 300 feet. Expressive architectural patterns are suggested by the structural frame.

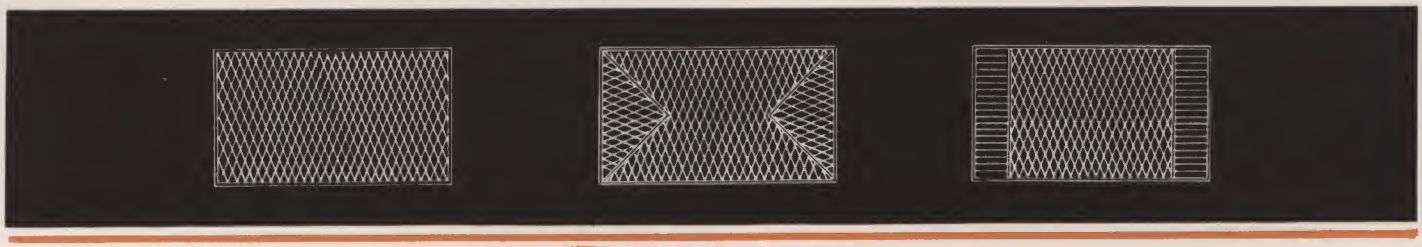
The Lamella Roof consists of individual lamella members joined together in a diamond pattern.

Various exciting ceiling treatments are possible through the use of natural or artificial lighting . . . or by establishing a particular motif through decorating the individual lamella. Fluor-Summerbell Roofs bring to modern wood construction the tradition of the barrel vault employed by builders since ancient Mesopotamia. Sound engineering principles based on contemporary vector analysis are employed to provide safe support for both vertical and lateral loads.

For gymnasiums, auditoriums, armories, theaters and similar buildings requiring unobstructed floor space lamella roof construction is ideal, and its diamond pattern adds to the acoustical properties of the building.

Distribution is limited in some areas. Please contact your local Fluor-Summerbell sales representative for complete information.

San Gabriel High School—Boys Gymnasium, San Gabriel, California
Architect: Marsh, Smith & Powell Contractor: Steed Brothers
This 97' x 112' lamella roof structure combines a clear roof span with excellent acoustic properties and eye catching design motif.



PURLINS

A WORD ABOUT FLUOR - SUMMERBELL GLUED LAMINATED WOOD PURLINS

Laminated wood purlins are produced with the same precision and quality control as Fluor-Summerbell Beams and Arches. These purlins are dimensionally stable; will not twist, warp or crack. In designing a structure with Fluor-Summerbell glued laminated wood units, architects are advised to specify our factory fabricated purlins to assure consistent quality in the finished structure.

Olympic Chapel, "Queen of the Snows," Squaw Valley, California
Architect: J. Clarence Felciano, Santa Rosa, California
Contractor: Riverman & Sons, Carmichael, California
Combined with Fluor-Summerbell Arches in a classic "A" frame, these laminated wood purlins provide both functional roof support and theme enhancing design elements.

Fluor PRODUCTS COMPANY

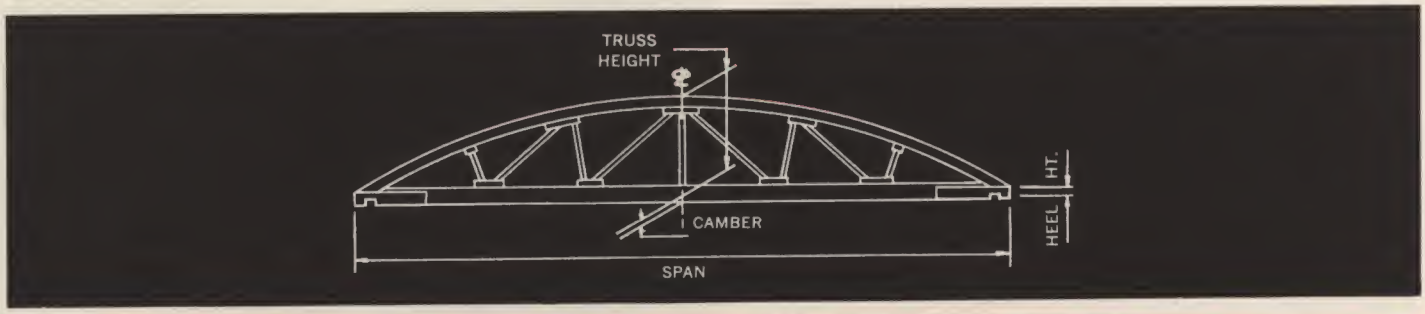
SUMMERBELL TRUSSES

TRUSS TABLE APPEARANCE GRADES

FLUOR - SUMMERBELL BOWSTRING TRUSSES

These systems are designed to meet the requirements of individual projects. The Bowstring Truss has chords of dimensionally stable glued laminated wood to carry symmetrical and unsymmetrical loadings.

Fluor-Summerbell recommends this type of roof structure for permanent, economical construction of industrial and commercial buildings where wide spans are required.



TYPICAL BOWSTRING ROOF TRUSS DATA

BASED ON UNIFORM LOADING = 1000 #/FT.

RADIUS = SPAN

ARC LENGTH = 1.0472 × SPAN

SPAN	50′	60′	70′	80′	90′	100′	110′	120′	130′	140′	150′
TRUSS HEIGHT	7′-2¼″	8′-7½″	11′-0½″	11′-5″	12′-9¼″	14′-2½″	15′-7″	17′-0″	18′ 5¼″	19′-10¼″	21′-2½″
HEEL HEIGHT	5″	6″	6″	7″	7″	8″	9″	9″	10″	10″	12″
CAMBER	2½″	3½″	4½″	5″	5½″	6″	6½″	7″	7½″	8″	8½″
NO. OF PANELS	8	10	10	12	12	14	14	14	16	16	18

STANDARD APPEARANCE GRADES FOR GLUED LAMINATED STRUCTURAL MEMBERS RECOMMENDED BY AMERICAN INSTITUTE OF TIMBER CONSTRUCTION & W.C.L.A.

Appearance grades apply to the surface of glued members and include such items as growth characteristics, inserts, wood fillers and surfacing operations but not laminating procedures, stains, paints, varnishes or other protective coverings. The appearance grades do not modify the design stresses, fabrication controls, grades of lumber used and other provisions of the standards for structural glued laminated lumber.

PREMIUM APPEARANCE GRADE

Specifications

(a) Laminations may contain the natural growth characteristics of the lumber grade.

(b) In exposed surfaces, voids which cannot be properly filled shall be replaced with clear wood inserts. This includes knot holes and loose knots in excess of ¾″ in diameter. Voids ¾″ in diameter and under shall have wood inserts or wood fillers. At the time of placement, insert shall be selected with special care to match grain and color. All such work shall be done by the fabricator.

(c) Soffit and face board material shall be clear and selected with reasonable care to match color and grain at scarf and edge joints.

(d) Exposed faces shall be surfaced smooth.

ARCHITECTURAL APPEARANCE GRADE

Specifications

(a) Laminations may contain the natural growth characteristics of the lumber grade.

(b) In exposed surfaces, voids which cannot be properly filled shall be replaced by the fabricator with clear wood inserts; this includes knot holes and loose knots in excess of ¾″ in diameter. At time of placement insert shall be selected with reasonable care to match grain and color. Filling of any remaining voids, if required, shall be left to other trades.

(c) Soffit and face boards shall be free of loose knots and open knot holes. The material shall be selected with reasonable care to match color and grain at scarf and edge joints.

(d) Exposed faces shall be surfaced. Misses are not permitted.

INDUSTRIAL APPEARANCE GRADE

Specifications

(a) Laminations may contain the natural growth characteristics of the lumber grade.

(b) Inserts or wood fillers are not required.

(c) Soffit and face boards shall be free of loose knots and open knot holes.

(d) Members shall be surfaced two sides only, permitting an occasional miss along individual laminations.

PRODUCTION AND FABRICATION

Fabrication of Fluor-Summerbell Glued Laminated Wood Roof Structures consists of bonding together graded moisture-controlled Douglas Fir with either water resistant casein or waterproof resorcinal glue.

(The type of glue is dependent on interior or exterior use.) All laminations are assembled to distribute scarfed joints throughout the lengtn of the unit and to minimize the number of joints in any cross-section.

Pressure, in accordance with the standards of the American Institute of Timber Construction and the Forest Products Laboratory (USDA), is maintained on all laminations to produce a perfect bond. Precision manufacture of each member is carried out as a continuous process in Fluor-Summerbell's modern plant.

SPECIFICATION CHECK SHEET FOR STRUCTURAL GLUED LAMINATED LUMBER

1. GENERAL

The glued laminated members shall be manufactured by Fluor Products Company, or approved equal. The manufacturer shall be a member of the A.I.T.C. with a minimum of five years of experience in the manufacture and fabrication of structural glued laminated lumber and shall provide proper plant facilities to perform the work specified. Field laminating will not be allowed.

2. WORK INCLUDED

The manufacturer shall furnish glued laminated lumber members as shown and detailed on the drawings and as specified herein (including or excluding) connection hardware and miscellaneous steel. Connection hardware and miscellaneous steel is defined as that which is required to securely fasten the furnished material to the supporting structure and to other material furnished, excluding tie rods, steel embedded in masonry or concrete or welded to structural steel which is to be furnished by others.

Member sizes shall be as shown on the drawings. Combination grade shall be: (select either a or b)

(a) (Specify combination number.)

(b) Selected by the manufacturer to provide normal working stress values of:

(1) ..... psi in bending and tension

(2) ..... psi in compression parallel to grain for ..... dry or ..... wet conditions of usage.

NOTE: Members which are stressed principally in compression and tension should be so designated on the drawings.

3. SHOP DRAWINGS

The manufacturer shall submit complete shop drawings for approval prior to fabrication.

4. MANUFACTURE

Fabrication and workmanship shall be in conformance with the current edition of both the "Design" and "Fabrication" sections of "Standard Specifications for Structural Glued Laminated Douglas Fir (Coast Region) Lumber" by the West Coast Lumbermen's Association, and the current edition of "Timber Construction Standards" by the American Institute of Timber Construction.

5. LUMBER

All lumber laminations shall be Coast Region Douglas Fir graded in accordance with current "Standard Grading and Dressing Rules" of the West Coast Lumbermen's Association, and as modified by the "Standard Specifications for Structural Glued Laminated Douglas Fir (Coast Region) Lumber—Fabrication" of the West Coast Lumbermen's Assocation. Lumber shall be properly dried to a moisture content approximating that which it will attain in service but shall not be less than 7% nor more than 12% (unless the condition of service warrants a higher moisture content).

6. END JOINTS

All end joints shall be peg scarfed with slope not steeper than 1:12. All portions of scarfs in adjacent laminations shall be separated by a minimum of 24" and there shall be at least two continuous laminations between scarfs at any cross section.

7. ADHESIVES

Adhesives shall be (selected per A.I.T.C. recommendations):

(a) .... Water and mold resistant casein type conforming to Federal Specification MMM-A-125. (Specify for which members.)

(b) .... Waterproof resorcinol or phenol resorcinol glue conforming to Federal Specifications MIL-A-397-B. (Specify for which members.)

Clamping time and room, material, and curing temperature shall be as required to comply with the above appropriate specification.

8. APPEARANCE GRADE (W. C. L. A.)

Grade of wood finish shall be:

(a) .... Industrial
(b) .... Architectural
(c) .... Premium

9. FINISH TREATMENT

Type of finish surface treatment shall be:

(a) .... None
(b) .... One coat penetrating sealer
(c) .... Other (Specify)

10. PROTECTION

Members shall be protected for shipment as follows:

(a) .... Not wrapped
(b) .... Individually wrap members
(c) .... Bundle wrap members

Paper used in wrapping shall be water-resistant and non-staining type. The erector shall be responsible for proper care and protection during unloading, hauling, and erection. All field trimmed ends or other surfaces shall receive a coat of sealer prior to erection.

11. IDENTIFICATION

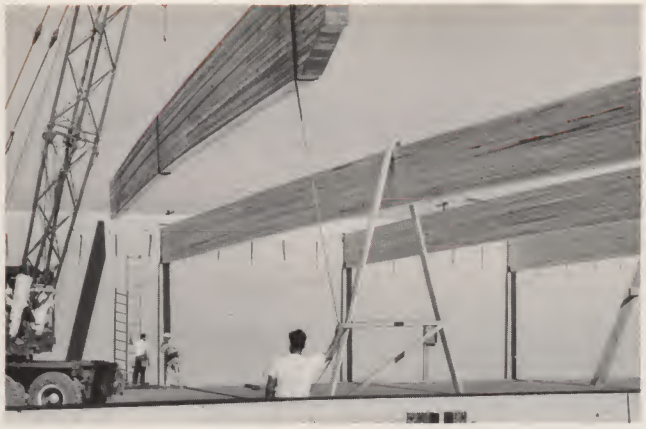
Each completed member shall bear a specific identification. When significant to the proper use, the top or bottom and north or east end shall be plainly marked.

12. INSPECTION

Fabrication inspection shall be:

(a) .... Plant Quality Control
(b) .... A.I.T.C.
(c) .... Independent agency to be paid for by .....

ERECTION ADHESIVES



ERECTION

Ease and speed of erection are some of the primary economics realized through the use of Fluor-Summerbell Wood Roof Structures. Individual members, manufactured to specified sizes and shapes, are delivered ready for immediate use. Placing members is a fast operation which fits easily into tight construction schedules, and requires only a minimum crew and equipment.

For example, over 1000 glued laminated wood beams and girders were used to roof over a 580,000 sq. ft. structure in the record time of 90 days. The structure, a distribution center in San Leandro, California, covers an area approximately equal to 10 football fields—yet the use of lightweight, glued laminated wood structures allow maximum utilization of the 13½-acre floor space.

For your convenience, Fluor-Summerbell erection crews and equipment are available to erect roof structures under the direct supervision of our Engineering staff. This is your assurance that arches, trusses, and beams are placed in the most efficient manner. In structures where Fluor-Summerbell Laminated Columns are specified, we erect them as well as the roof structure.

SHIPPING AND PACKING

We deliver roof structures from our plant directly to your job. Packing and full protection in transit are our responsibilities. Every safety measure is provided to assure complete customer satisfaction.

ADHESIVES

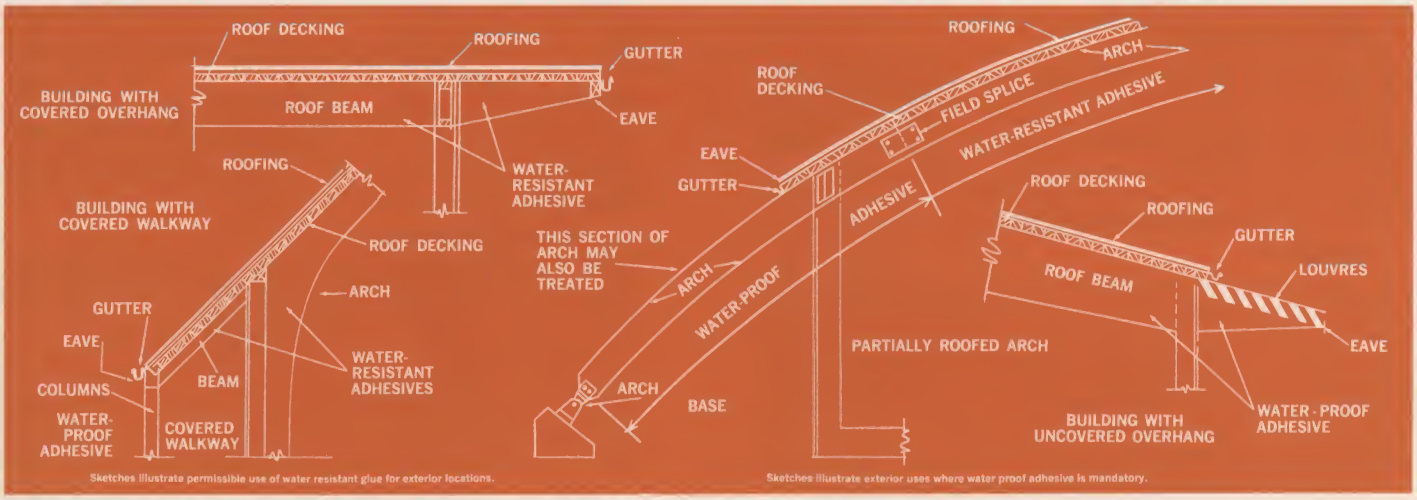
The glue line is one of the most important, single components in maunfacture of structural, glued laminated timbers. Strength and durability of the glue line depend upon:

The type of glue used.
The gluing technique.
Characteristics of the finished glue line.
The in-use service conditions.

The in-use service conditions of moisture can best be determined by the designer who then decides upon the type of glue to be used. Control of all other variables which determine the ultimate strength and durability of the glue line is then the laminator's responsibility.

It should be noted that in-use conditions of moisture (and seasonal changes of moisture) not only effect the durability of the glue line, but also the equilibrium moisture content of the wood, and seasoning checks could become a problem. When design conditions indicate that checking could be a problem, a moisture content range for the lumber of 7% to 12% should be specified. In general, lumber glued with the water proof resin adhesives has less tendency to check under dry use conditions than if glued with casein or urea adhesives.

Adhesives should be selected in accordance with the latest AITC Recommendations; latest caseins to conform to Federal Specifications MMM-A-125; and resorcinol-phenol resorcinols to Federal Specifications MIL-A-397-B as assembled for General Service use. Clamping times and room, material, and curing temperatures shall be as required to comply with the appropriate above specifications.



QUALITY CONTROL

Fluor-Summerbell Inspection and Quality Control Departments carry on a continuous drive to improve and refine industry operating practices and techniques. These efforts are the customer's guarantee of our adherance to his requirements and specifications.

Thirteen individual inspections are made during fabrication to obtain the desired degree of permanence in each individual member produced. The principal stations for the Fluor-Summerbell continuous process inspections are:

1. Primary grade check and regrading of incoming rough green lumber for special laminating grade requirements.
2. Moisture content and seasoning test during kiln-drying.
3. Moisture content of stored dry lumber.
4. Second grade check during initial preparation of individual boards.
5. Final surfacing tolerances.
6. Scarf slope, dowel-hole centering and surface smoothness check.
7. Lay-up (assembly) check for grade requirements and positioning.
8. Glue temperatures, components of mix and pot life test.
9. Rate of glue spread in accordance with current temperatures, humidity and assembly schedule.
10. Rack settings, laminating pressures, temperatures and curing times.
11. Dimensional check during planing.
12. Block-shear test of glue lines.
13. Glue line durability test.
14. Finish inspection of pre-fab cutting, appearance grade requirements, sealing and wrapping.

Inspection data are recorded, evaluated, and used as the basis for adjustments made during the fabrication process, to compensate for changes in lumber, glue, and weather conditions.

DIGITAL COMPUTER WORKS FOR YOU

Fluor's new Digital Computer is the first computer system to be applied to the problems of glued laminated wood structures. The "brain" can read or write 4,000 words every eight seconds, and perform 30,000 additions and subtractions, or 7,200 multiplications, or 5,100 divisions per minute.

The Computer will benefit Fluor-Summerbell customers in many ways: it will relieve engineers and estimators of time-consuming routine calculations, allowing them to devote more time to actual customer service; it will advance completion of customer projects by speeding the solutions of design problems; it will expedite the solution of research problems—which means better products, sooner, for you; it means greater accuracy in all mathematical operations, which means savings to you in less waste motion and less waste materials.

ENGINEERING SERVICE

DESIGN (May be included with architect or engineers specifications.)

Member sizes shall be determined by the manufacturer in accordance with conventional engineering principles as governed by the standards specified under manufacture and by other local code requirements.

Selection of combination grade shall be made by the manufacturer to comply with engineering and appearance requirements. The members shall be designed for the following loading and limitations:

Dead Load: . . . . . lbs./sq. ft. (not including lam. member)

Live Load: . . . . . lbs./sq. ft. (type or duration)

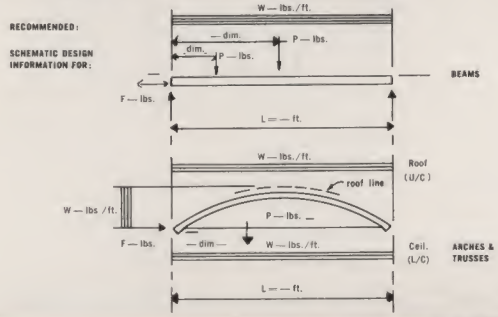
Wind Load: . . . . . lbs./sq. ft. (acting horiz. on vert. projection)

Other Loads: . . . . . Specify equipment loads, horizontal reaction from columns or struts, chord action for diaphragms, etc.

Deflection Limit: . . . . Ratio of span.

. . . . . Wet or . . . . . Dry condition of usage.

The manufacturer shall submit engineering calculations for approval prior to fabrication.



Entering a problem in the Computer.

Fluor
PRODUCTS COMPANY

SUMMERBELL
FACILITIES

FLUOR - SUMMERBELL FACILITIES

For over 30 years Fluor-Summerbell has been recognized as a leader in the development of wood structures. The original Summerbell company began operations in Los Angeles in 1922 and pioneered work in the glued-laminated wood field back in 1938. Then in 1958, Summerbell was acquired by The Fluor Corporation, Ltd., since 1919 a world leader in the engineering, manufacture, and construction of wood products and cooling towers.

The Summerbell operations and mill were moved to Santa Rosa and integrated with Fluor's manufacturing facilities (that produce a major portion of the nation's industrial and air conditioning cooling towers, wood tanks and wood pipe). With the engineering and corporate support acquired as a result of the merger, Summerbell quickly attained a primary position among the major designers, fabricators and erectors of glued-laminated wood roof structures.

To date more than 6,000 individual projects utilizing Fluor-Summerbell-engineered structures have been completed. The modern laminating plant at Santa Rosa, California, is one of the most thoroughly equipped facilities serving the industry today. The new plant permits full use of continuous production methods with most modern quality control procedures. We sincerely hope these descriptions and tables will prove a helpful source of information for you . . . and earn this booklet a place in your top drawer.

Aerial view of the Fluor 40 acre plant and general offices at Santa Rosa, California.

105' Fluor-Summerbell Glued Laminated Wood Beams—being loaded at Santa Rosa plant for shipment across the country.

Fluor
PRODUCTS COMPANY

a division of The FLUOR CORPORATION, Ltd.

Summerbell
roof structures

GENERAL OFFICES
SANTA ROSA, CALIFORNIA: Write Box 1267
Telephone Liberty 2-2281

Representatives throughout the United States

AITC
AMERICAN INSTITUTE OF TIMBER CONSTRUCTION
ENGINEERED TIMBER

LITHO IN U.S.A.–6/60/5M

Fluor
PRODUCTS COMPANY

SUMMERBELL
FACILITIES

Digitized by:

API
INTERNATIONAL

ASSOCIATION FOR PRESERVATION TECHNOLOGY
www.apti.org

For the

BUILDING TECHNOLOGY HERITAGE LIBRARY

https://archive.org/details/buildingtechnologyheritagelibrary

From the collection of:

Tulane University | SOUTHEASTERN ARCHITECTURAL ARCHIVE
SPECIAL COLLECTIONS
HOWARD-TILTON MEMORIAL LIBRARY

http://seaa.tulane.edu

FLUOR - SU

For over 3(
as a leader
original Sur
geles in 19
wood field b
quired by T
leader in the
wood produ

The Summe
Rosa and in
(that produc
air condition
With the en
result of the
position amc
of glued-lam

To date mor
Summerbell-
modern lami
the most tho
today. The n
tion methods
We sincerely
a helpful sou
booklet a pla

Fluor
PRODUCTS COMPANY

a division of The FLUOR CORPORATION, Ltd.

Summerbell
roof structures

GENERAL OFFICES
SANTA ROSA, CALIFORNIA: Write Box 1267
Telephone Liberty 2-2281

Representatives throughout the United States

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION
ENGINEERED AITC TIMBER

LITHO IN U.S.A.–6/60/5M